Comment Location	Commenter	Comment Document / Comment No.
12 (139) (continued)	Shrader-Frechette, Kristin	EIS001522 / 0019
	Smith, Kathleen	EIS001749 / 0003
	Shundahai Network	EIS001907 / 0016
	Snyder, Susi	
		EIS002247 / 0013
	Sontag, Fran	EIS001748 / 0001
	Shundahai Network	EIS002249 / 0006
	Sullivan, Graham	
	Sutton, Robert	EIS001008 / 0001
	The Hopi Tribe	010042 / 0007
	Taylor, Wayne	
		010091 / 0009
	Treacy, Rosemary	EIS000239 / 0002
	Walsh, Jane	EIS002148 / 0002
	White, Delores	EIS001454 / 0005
	Wissbeck, Larry	EIS000688 / 0001
	Clark County, Nevada, Board of County Commissioners	EIS001888 / 0148
	Woodbury, Bruce	
	Shundahai Network	EIS002099 / 0007
	Xenos, Michelle	
	Blue Ridge Environmental Defense League	EIS000296 / 0008
	Zeller, Janet	
	Zolkover, Adrian	EIS000714 / 0003
		EIS002126 / 0004
12 (1399)	Nuclear Information and Resource Service	EIS000294 / 0005
	Olson, Mary	
12 (1614)	Ludlow, Grant	EIS000104 / 0002
12 (7259)	Tennessee Valley Authority	EIS001190 / 0006
	Burzynski, Mark	
	Nuclear Energy Institute	EIS001832 / 0006
	Kraft, Steven	
12 (7276)	Nevada, State of, Office of the Governor, Agency for Nuclear Projects	EIS001887 / 0445
	Loux, Robert	
	Malone, Charlie	EIS001106 / 0018
12 (7283)	Malone, Charlie	EIS001106 / 0019
12 (8838)	Florida, State of, Public Service Commission	EIS000216 / 0009
	Clark, Susan	
12 (10354)	Hunter, Meredith	EIS001371 / 0002
12 (10489)	deBottari, Louis	EIS002138 / 0004
12 (10754)	Heath, Roy	EIS002145 / 0001
12 (11184)	Allister, Pam	EIS000249 / 0003
12 (12102)	Nevada, State of, Office of the Governor, Agency for Nuclear Projects	EIS001887 / 0402
	Loux, Robert	
12 (12103)	Nevada, State of, Office of the Governor, Agency for Nuclear Projects	EIS001887 / 0403
	Loux, Robert	
12 (12104)	Nevada, State of, Office of the Governor, Agency for Nuclear Projects	EIS001887 / 0404
	Loux, Robert	
13 (5)	Adams, JoAnn	EIS000874 / 0002
	Alexander, Cheryl	EIS000255 / 0005

Comment Location	Commenter	Comment Document / Comment No.
13 (5) (continued)	Earth Challenge	EIS000289 / 0009
	Alzner, Susan	
	WILPF	010465 / 0002
	Anderson, Gloria-Jeanne	
	Anonymous	010294 / 0006
	Bailey, John	EIS001841 / 0003
	Illinois Peace Action	EIS001674 / 0001
	Balch, Jeff	
	Barfield, Ellen	EIS000454 / 0002
	Barnes, Judy	EIS001650 / 0004
	Barrowes, Steven	EIS000927 / 0002
	Bastin, Clinton	EIS000815 / 0009
	Bayne, Luke	EIS000064 / 0002
	Bayne, Luke	EIS000577 / 0003
	Bedonie, Tom	EIS001773 / 0002
	Berenson, David	EIS001560 / 0002
	Bianchi, Vince	EIS000929 / 0007
	Bingham, Lisa	EIS001694 / 0002
	Blank, Erika	EIS000426 / 0007
	Bolten, Kim	EIS001131 / 0003
	Botwinick, Joan	EIS000436 / 0003
	Brakefield, Zac	EIS001304 / 0002
	Bratton, Tara	EIS002160 / 0001
	Burns, David	EIS001360 / 0002
	Caligiuri, Irene	EIS000749 / 0002
	Campanella, JoAnne	EIS002185 / 0002
	Prairie Island, Minnesota, City of	EIS000456 / 0005
	Campbell, Darrell	
	Caraccio, Laura	EIS001687 / 0005
	Beowawe Crescent Valley Nuclear Waste Awareness Committee	EIS000623 / 0005
	Carruthers, Joseph	
		EIS000642 / 0006
	Caudle, Joe	EIS001301 / 0001
	Green Party of St. Louis	EIS000987 / 0004
	Chicherio, Barbara	
	Christie, Iryne	EIS001128 / 0001
	Circost, Namaskar	EIS000905 / 0008
	Citron, Kay	EIS000167 / 0005
	International Brotherhood of Electrical Workers Local 15	EIS001582 / 0001
	Citta, Nick	
	Clark, Darlyne	EIS001495 / 0002
	Cocke, Marie	EIS001943 / 0007
	Collins, Kevin	EIS000324 / 0002
	Congdon, Lois	EIS000306 / 0005
	Conway, Ursula	EIS000784 / 0003
		EIS002155 / 0006
	Cox, Barbara	EIS001217 / 0002
	Damel, David	EIS001278 / 0006
	Western Shoshone Defense Project	EIS001965 / 0007
	Dann, Carrie	
	American Nuclear Society, Savannah River Section	EIS000300 / 0006
	Dewes, John	
	Divis, Mary-Jo	EIS001352 / 0002

Comment Location	Commenter	Comment Document / Comment No.
13 (5) (continued)	Drey, Kay	EIS001000 / 0003
		EIS001736 / 0003
	International Brotherhood of Electrical Workers	EIS000448 / 0001
	Dushaw, James	
	Dziegiel, Henry	010261 / 0006
	Sargent & Lundy Engineers	EIS001581 / 0001
	Erler, Bryan	
	Estella, Lucille	EIS001071 / 0004
	Estreito, Anthony	EIS001132 / 0003
	Falk, Vera	EIS001753 / 0005
	Felkner, Larry	EIS000979 / 0001
	Fish, Faith	EIS000020 / 0001
	Folsom, Therese	EIS001647 / 0004
	Foxworth, Margaret	EIS000321 / 0002
	Friedman, Maurice	EIS002179 / 0002
	Fritz, Edward	EIS001293 / 0002
		EIS001562 / 0002
	Gann, Dawn	EIS001348 / 0002
	Gannis, Steve	EIS001555 / 0003
	Gehr, Patricia	EIS001101 / 0006
	Gilleo, Margaret	EIS001393 / 0002
	Gimsky, Ken	EIS001357 / 0002
	Gledhill, Elizabeth	EIS000419 / 0002
	John P.Gnaedinger Research Corp.	EIS001594 / 0002
	Gnaedinger, John	
	Goldberg, Leah	EIS000396 / 0001
	Gondzur, Andrew	EIS001080 / 0002
	Gordon, Lenore	EIS001496 / 0002
	Gordon, William	EIS001345 / 0002
	Grace, Ana	EIS001791 / 0001
	Gratrix, Bob	EIS002159 / 0004
	Grazier, Bill	010086 / 0001
	Griffeth, Carolyn	EIS001667 / 0003
		EIS001685 / 0005
	Griswald, Diane	EIS001368 / 0002
	Guenther, Charles	EIS001440 / 0002
	Citizen Alert	EIS002284 / 0001
	Hadder, John	
	Hatfield, Scott	EIS000500 / 0003
	Hauser, Lenore	EIS001431 / 0002
	Hebert, Donna	EIS000526 / 0005
	Hellgeth, Jeanette	EIS000956 / 0003
	Hendricks, Karen	EIS001350 / 0002
	Henze, Walter	EIS001389 / 0006
		EIS001858 / 0002
	Ursuline Sisters of Kirkwood	EIS001173 / 0002
	Hickey, Julie	
	Holek, Stan	EIS001359 / 0002
	Hopper, Heidi	EIS001428 / 0002
	Illegible	EIS001346 / 0002
		EIS001364 / 0002
		EIS001487 / 0002
		EIS001491 / 0002
		EIS002006 / 0004

Comment Location	Commenter	Comment Document / Comment No.
13 (5) (continued)	Illegible, Garry	EIS001367 / 0002
	Illegible, Patricia	EIS001356 / 0002
	Jacobson, Joan	EIS001084 / 0004
	League of Women Voters	EIS001586 / 0001
	Johnson, Betty	
	Johnston, Art	EIS000389 / 0002
		EIS001059 / 0001
	Jordan, Susan	EIS001439 / 0004
	Jose, Joshua	EIS001675 / 0001
	Nuclear Information and Resource Service	EIS001471 / 0007
	Kamps, Kevin	
		EIS001474 / 0009
	Positives for Peace and Environmental Justice	EIS001312 / 0002
	Karch, Gary	
	Kean, Beth	EIS001409 / 0005
	Shundahai Network	EIS001465 / 0002
	Knutsen, Reinard	
		EIS001480 / 0002
		EIS002135 / 0003
		EIS002252 / 0005
	U.S.Chamber Business	EIS000447 / 0003
	Kovacs, Bill	
	Kring, Bernice	EIS001448 / 0002
	Kuchuris, Christopher	010112 / 0004
	Kuck, Kay	EIS000317 / 0001
	Kunkel, Michael	010458 / 0002
	Ohio Citizen Action	EIS001568 / 0002
	Lauber, Maureen	
	Leclercq, Carol Jene	EIS000563 / 0002
	Lems, Kristin	EIS001595 / 0006
	Lems-Dworkin, Carol	EIS001324 / 0009
		EIS001437 / 0013
	Lewis, Jay	EIS001024 / 0002
	Lindecke, Fred	010001 / 0001
	Lindstrom, Richard	EIS000329 / 0003
	Lipe, Marrianna	EIS001363 / 0002
	Maple, Susan	EIS001340 / 0005
	Marlovitz, Linda	EIS001604 / 0003
	Marsden, Velma	EIS001494 / 0002
	Marsh, Amy	EIS000499 / 0010
	Mayes, Susan	EIS002281 / 0006
	Mays, Gordon	EIS001347 / 0002
	Mays, Wallace	EIS000493 / 0003
	U.S. House of Representatives - Georgia	EIS000271 / 0003
	McCall, Tom	
	McClarren, Thomas	EIS001764 / 0007
	McClellan, Brad	EIS000548 / 0002
	McGraw, John	EIS000628 / 0001
	Meadows, Lora	EIS001983 / 0002
	Mihill, Doris	EIS001339 / 0002
	Ohio, State of, Ohio House of Representatives	EIS001280 / 0005
	Miller, Dale	
	Miller, Kit	EIS000352 / 0004
	Miller, Michael	010446 / 0002

Comment Location	Commenter	Comment Document / Comment No.
13 (5) (continued)	Miller, William	EIS001037 / 0004
	Molloff, Jeanine	EIS001766 / 0005
	Money, Daniel	EIS001960 / 0002
	Oregon State University	010427 / 0002
	Moore, Erin	
	Mount, George	EIS002279 / 0001
	Mount, Julia	EIS002280 / 0001
	Waste Ideas Network	EIS001318 / 0002
	Mullarkey, Barbara	
	Myers, Sarah	EIS001016 / 0003
		EIS001779 / 0008
	Nazario, Joseph	EIS001355 / 0002
	Niemann, Josephine	EIS001073 / 0002
	O'Connor, Amy	EIS000766 / 0006
		EIS001478 / 0006
	Ochs, Richard	EIS000453 / 0004
	Okenfuss, Elizabeth	EIS000978 / 0001
	Olson, Mary	EIS000325 / 0003
	Women's Action for New Directions Education Fund	EIS000160 / 0006
	Ortmeyer, Pat	
		EIS000292 / 0006
	Overland, Carol	EIS001966 / 0012
	Ozbakan, Kristine	EIS000395 / 0002
	Page, Marc	EIS001279 / 0001
	Panning, Adeil	EIS001362 / 0002
	Pemelton, Jack	EIS001351 / 0002
	Perkins, Jerry	EIS001493 / 0002
	Perna, Frank	EIS001049 / 0004
	Perry, Gavin	EIS000997 / 0002
		EIS001734 / 0007
	Petersen, Art	EIS001377 / 0014
		010485 / 0009
	Pfiester, Carolyn	EIS002168 / 0006
		010365 / 0001
	Plummer, Nancy	EIS001231 / 0001
		EIS001243 / 0007
	Pulsipher, Rick	EIS001532 / 0001
	Raddatz, Alan	EIS001913 / 0002
	Rash, Dennis	EIS001575 / 0003
	Rathburn, Lesley	EIS000327 / 0004
	Reimer, Nancy	EIS001204 / 0013
	Richards, Karla	EIS001670 / 0004
	Robertson, Henry	EIS000974 / 0003
	Rogers, Stephen	EIS001077 / 0003
	Schirn, Jackie	EIS001055 / 0003
		EIS001785 / 0002
	Schosser, Claire	EIS001222 / 0008
	Schroeder, Linda	EIS000501 / 0004
	GREEN Party of California	EIS000722 / 0001
	Schumann, Klaus	
		EIS002100 / 0001
	Scott, Jay	EIS001366 / 0002
	Sellard, Lon	EIS001361 / 0002
	Sellard, Nancy	EIS001354 / 0002

Comment Location	Commenter	Comment Document / Comment No.
13 (5) (continued)	Sellard, Robert	EIS001349 / 0002
	Shillinglaw, Fawn	EIS000817 / 0035
	Singer, Stacy	EIS000314 / 0002
	Sipp, Valarie	EIS000311 / 0002
	Smith, Doris	EIS001358 / 0002
	Smith, Kathleen	EIS001749 / 0006
	Smith, Fred	EIS001353 / 0002
	Smith, Vanecia	EIS001053 / 0002
	Smucker, Richard	EIS000736 / 0002
	Shundahai Network	EIS002133 / 0002
	Snyder, Susi	
		EIS002199 / 0001
		EIS002247 / 0011
	Stachunska, Agnes	EIS001054 / 0002
	Shundahai Network	EIS001840 / 0006
	Sullivan, Graham	
	Sunnes, Bradley	EIS000345 / 0004
	Swanson, Rochelle	EIS000600 / 0003
	Tebbetts, Chartis	EIS001066 / 0003
	Educational Directions	EIS000180 / 0003
	Telfer, Richard	
	Terry, Susan	EIS000579 / 0001
	Thallheimer, George	EIS001507 / 0002
	Thomas, Steven	EIS001795 / 0002
	Tilton , Bill	EIS001490 / 0002
	Tilton, Dorothy	EIS001488 / 0002
	Gas Technology Institute	010430 / 0002
	Villaire, Louis	
	Citizens Action Coalition of Indiana	EIS001590 / 0001
	Voelker, Roger	
	Walton, Barbara	EIS001430 / 0001
	Ward, Fay	EIS001489 / 0002
	Weber, Dan	EIS000582 / 0002
	Ohio Public Industry Research Group	EIS001550 / 0007
	Weidner, Maria	
	Welsh, Thomas	EIS001722 / 0006
	Weston, Michele	EIS000508 / 0001
	Prairie Island Indian Community	EIS000490 / 0005
	White, Byron	
	White, Laura	EIS001629 / 0005
	Wilcox, Robert	EIS000181 / 0004
	Williams, Terri	EIS001032 / 0003
	Wilson, Debra	010085 / 0004
	Wilson-Booth, Ursula	EIS000813 / 0001
	Winslow, Geralyn	EIS001108 / 0001
	Americans for Clean Responsible Energy	EIS002266 / 0001
	Wolfe, Bertram	
	Wootan, Cathy	EIS001221 / 0002
	Wright, Patricia	EIS001365 / 0002
	Shundahai Network	EIS002099 / 0003
	Xenos, Michelle	
	Young, Jim	EIS001001 / 0004
13 (35)	Georgians for Clean Energy	010260 / 0006
	Barczak, Sara	

Comment Location	Commenter	Comment Document / Comment No.
13 (35) (continued)	Barrowes, Steven	010284 / 0001
	Chastain, E.	010002 / 0004
	Hopkins, Steve	EIS000250 / 0008
	King, Joan	010012 / 0002
	Shundahai Network	EIS001480 / 0004
	Knutsen, Reinard	
	Perna, Frank	EIS001049 / 0003
	Pfiester, Carolyn M.	010365 / 0002
	Rogers, Stephen	EIS001077 / 0002
	Blue Ridge Environmental Defense League	EIS000217 / 0006
	Zeller, Janet	
		EIS000296 / 0004
13 (37)	Andrus, Calvin	EIS001468 / 0003
	Georgians for Clean Energy	010260 / 0002
	Barczak, Sara	
	Benezet, Louis	EIS002158 / 0003
	Devlin, Sally	010268 / 0005
		010305 / 0005
	Mineral County, Nevada, Board of Commissioners	010182 / 0023
	Funk, Arlo	
	Hanson, Jo	EIS001509 / 0002
	Hoyt, Becky	EIS002053 / 0002
	League of Women Voters	EIS001586 / 0003
	Johnson, Betty	
	Ohio Citizens Against a Radioactive Environment	EIS001288 / 0003
	Kline, Connie	
		EIS001551 / 0002
	Mahr, Ed	EIS001804 / 0001
	Prairie Island Indian Community	EIS000328 / 0001
	NoLastName	
	Reed, Don	EIS002146 / 0006
	Shillinglaw, Fawn	EIS000817 / 0077
	Zolkover, Adrian	EIS002126 / 0006
13 (72)	OGD Awareness	EIS001459 / 0001
	Bullcreek, Margene	EIS001475 / 0008
		EIS002106 / 0006
	Nuclear Information and Resource Service	EIS001471 / 0008
	Kamps, Kevin	
	Shillinglaw, Fawn	EIS000817 / 0151
	Ungricht, Margo	EIS001152 / 0001
		EIS001153 / 0001
		EIS001154 / 0001
13 (131)	Darby, Forrest	EIS002140 / 0003
	Friedman, Maurice	EIS002179 / 0001
	Healy, Gretchen	EIS000951 / 0001
	Kuntz, Felix	EIS001126 / 0005
	McFail, Edward	EIS000856 / 0001
	Mitchell, Kirsten	EIS002290 / 0001
	Pappas, Carmen	EIS001413 / 0002
	Redden, Geri	EIS001803 / 0001
	Wilson, David	EIS000977 / 0002
		EIS001127 / 0005
13 (211)	OGD Awareness	EIS002106 / 0002
	Bullcreek, Margene	

Comment Location	Commenter	Comment Document / Comment No.
13 (211) (continued)	Cahall, Diana	EIS001952 / 0007
	Dallas, Don	EIS002105 / 0002
	Detraz, Marjorie	EIS002128 / 0001
	Devlin, Sally	010162 / 0005
	Downwinders	EIS001464 / 0001
	Erickson, Steve	
	Grey, Marty	EIS001202 / 0005
	Negin, Gary	EIS002260 / 0002
13 (227)	Conn, Corey	EIS001321 / 0002
	Dziegiel, Henry	010028 / 0005
		010311 / 0012
	Nuclear Information and Resource Service	EIS000467 / 0007
	Kamps, Kevin	EIS001561 / 0003
	Shundahai Network	EIS000458 / 0010
	Knutsen, Reinard	
	Perna, Frank	010110 / 0003
	Nevada Nuclear Waste Task Force, Inc.	010123 / 0005
	Treichel, Judy	
13 (618)	Wilcox, Robert	EIS000181 / 0005
13 (1138)	Sierra Club	EIS000270 / 0025
	Maret, Susan	
13 (1205)	Georgia, State of, House of Representatives	EIS000272 / 0002
	Orrock, Nan	
13 (1243)	Raddatz, Alan	010093 / 0002
13 (1548)	White Pine County, Nevada	EIS000357 / 0007
	Baughman, Mike	
	White Pine County, Nevada, Board of County Commissioners	EIS001160 / 0065
	Eldridge, Brent	
	Ely Shoshone Tribe	EIS001441 / 0061
	Kaamasee, Arthur	
13 (1906)	Nester, Dennis	EIS000464 / 0002
13 (2004)	Jones, Terry	EIS000528 / 0001
13 (2072)	Thompson, James	EIS000765 / 0002
13 (2628)	Zolkover, Adrian	EIS000714 / 0004
13 (2790)	Dugan, Barbara	EIS000882 / 0003
13 (2793)	Minghi, John	EIS000887 / 0003
13 (3206)	Siller, Barbette	EIS001133 / 0003
13 (3657)	Perez, Barbara	EIS000926 / 0007
13 (3921)	Cleveland Peace Action	EIS001287 / 0001
	Chiappa, Francis	
13 (3962)	Cleveland Peace Action	EIS001547 / 0001
	Chiappa, Francis	
13 (4139)	Wilson, David	EIS001127 / 0002
13 (4337)	Grey, Marty	EIS001202 / 0007
13 (4687)	Nuclear Information and Resource Service	EIS001471 / 0001
	Kamps, Kevin	
13 (4801)	Gateway Green Alliance	EIS001535 / 0004
	Romano, Daniel	
13 (4862)	DeFelice, Holly	EIS001708 / 0002
13 (4893)	deBottari, Louis	EIS000337 / 0033
13 (4980)	Hackert, David	010144 / 0002
13 (5218)	Brennan, Michael	EIS001322 / 0001
13 (5555)	Weinberg, Piper	010235 / 0008
13 (5642)	Delcoure, Sandra	010100 / 0003

Comment Location	Commenter	Comment Document / Comment No.
13 (5917)	Bastin, Clinton	EIS000815 / 0007
13 (6781)	Devlin, Sally	010141 / 0001
13 (6792)	Vasconi, Bill	010133 / 0002
13 (6959)	Perna, Frank	010134 / 0002
13 (7200)	Devlin, Sally	010162 / 0002
13 (7352)	Toledo Coalition for Safe Energy Lodge, Terry	EIS001573 / 0004
13 (8019)	Shillinglaw, Fawn	EIS000817 / 0070
13 (8244)	Shundahai Network Sullivan, Graham	EIS002286 / 0004
13 (8265)	Law, Martha	EIS001950 / 0005
13 (8352)	Pennsylvania, Commonwealth of, Public Utility Commission Barth, Lawrence	EIS001627 / 0004
13 (8497)	Shillinglaw, Fawn	EIS000817 / 0159
13 (8550)	Lindberg, Jay	EIS002283 / 0002
13 (8682)	People Against Radioactive Dumping Lopez, Ruth	EIS001837 / 0034
13 (9145)	Eide-Tollefson, Kristen	EIS001971 / 0002
13 (9180)	Detraz, Marjorie	EIS002123 / 0002
13 (9207)	Darby, Forrest	EIS002140 / 0005
13 (9440)	Page, Marc	010129 / 0002
13 (9827)	Clark County, Nevada, Board of County Commissioners Woodbury, Bruce	EIS001888 / 0404
13 (10660)	Nester, Dennis	EIS002102 / 0004
13 (10724)	Craig, Robin	EIS002170 / 0008
13 (10728)	Pawlak, John	EIS000123 / 0002
13 (10777)	Hopkins, Steve	EIS000250 / 0011
13 (10920)	Idaho, State of, House of Representatives Barraclough, Jack	EIS000244 / 0005
13 (10946)	Nuclear Information and Resource Service Kamps, Kevin	EIS000467 / 0008
13 (10958)	Cahall, Diana	EIS001424 / 0003
13 (11056)	Cahall, Diana	EIS000475 / 0011
13 (11083)	Earth Challenge Alzner, Susan	EIS000309 / 0001
13 (11149)	Goad, Ken	EIS000320 / 0001
13 (11457)	Perna, Frank	010080 / 0005
13 (11458)	Perna, Frank	010080 / 0004
13 (11509)	Barfield, Ellen	EIS000454 / 0003
13 (11735)	Grazier, Bill	010032 / 0001
13 (12298)	Citizen Alert Tilges, Kalynda	010138 / 0001
13 (12368)	Shundahai Network Snyder, Susi	010139 / 0004
13 (12583)	Bastin, Clinton	EIS000815 / 0005
13 (12874)	Vaughan, James	010297 / 0001
13 (13123)	Wright, Rebecca	010298 / 0010
13 (13131)	Young, Jim	010236 / 0005
13 (13200)	Nuclear Information and Resource Service Kamps, Kevin	010246 / 0010
13 (13332)	Page, Marc	010129 / 0005
13 (13340)	Getty, Greg	010161 / 0002

KEY AGENCY COMMENTS AND RESPONSES

Section 114 (a)(1)(D) of the NWPA specifies that any site recommendation by the Secretary of Energy submitted to the President must include comments on the EIS received from four Federal agencies—the Department of the Interior, the President's Council on Environmental Quality, the Environmental Protection Agency, and the Nuclear Regulatory Commission. This section of the Comment-Response Document includes copies of the comments from these agencies on the Draft EIS and Supplement to the Draft EIS, followed by responses to the comments. DOE has included these materials as a convenience for these agencies as they review the Final EIS. The information in this section includes the following:

1. U.S. Department of the Interior

    a. Comments on the Draft EIS - Comment Document 1969
    b. Comments on the Supplement to the Draft EIS – Comment Document 10066

2. U.S. Environmental Protection Agency

    a. Comments on the Draft EIS - Comment Document 1632
    b. Comments on the Supplement to the Draft EIS – Comment Document 10231

3. U.S. Nuclear Regulatory Commission

    a. Comments on the Draft EIS - Comment Document 1898
    b. Comments on the Supplement to the Draft EIS – Comment Document 10248

The President's Council on Environmental Quality did not comment on the Draft EIS or the Supplement to the Draft EIS.

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, D.C. 20240

In Reply Refer to:
ER 99/712

EIS001969

FEB 28 2000

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MAR 07 2000

Wendy R. Dixon
EIS Project Manager
Yucca Mountain Site Characterization Office
Office of Civilian Radioactive Waste Management
U.S. Department of Energy
P.O. Box 30307, Mail Stop 010
North Las Vegas, Nevada 89036-0307

Dear Ms. Dixon:

The United States Department of the Interior (Department) has reviewed the draft environmental impact statement (DEIS) for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada, and offers the following comments.

BACKGROUND INFORMATION

The Nuclear Waste Policy Act (NWPA) was enacted by Congress in 1982 in recognition of the need to provide for the permanent disposal of spent nuclear fuel and high-level radioactive waste in the United States. Currently, approximately 70,000 metric tons of heavy metal (MTHM) of spent nuclear fuel and high-level radioactive waste is housed at some 77 sites across the United States. In 1986, the Department of Energy (DOE) narrowed the number of potentially acceptable sites for a geologic repository to three (3) sites in three (3) States. However, Congress in 1987 amended the NWPA and directed the Secretary of Energy to characterize only the Yucca Mountain as a potential location for a geologic repository, setting forth a process for the Federal Government to decide whether to designate Yucca Mountain as the site for a repository. Yucca Mountain is located in Nye County, Nevada, approximately 100 miles northwest of Las Vegas, Nevada, on the western boundary of the Nevada Test Site (NTS).

POTENTIAL ADVERSE IMPACTS TO BIOLOGICAL RESOURCES

1... The Department's Fish and Wildlife Service (Service) is responsible for protection of trust resources which include species listed as threatened or endangered under the Endangered Species Act of 1973 (ESA), as amended, birds protected under the Migratory Bird Treaty Act, and other biological resources managed under the National Wildlife Refuge (NWR) System. The Service is concerned with possible adverse effects to these and other resources that could

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1 cont. result from the operation of the Yucca Mountain facility. Trust resources on or in the vicinity of the proposed waste storage facility include the following:

- Yucca Mountain is at the northern edge of the range for the desert tortoise (*Gopherus agassizii*) which is listed as threatened under the ESA. On July 23, 1997, the Service issued a biological opinion to DOE for programmatic activities associated with site characterization studies at Yucca Mountain (File No. 1-5-96-F-307R).

- Rainfall runoff accumulating in low lying areas at the NTS such as Frenchman Flat, attract migratory birds to the area.

- The Desert National Wildlife Range, located approximately 30 miles to the east of the proposed repository, provides habitat for numerous wildlife species that are unique to the Mojave Desert ecosystem.

- The Ash Meadows NWR is located approximately 25 miles south of Yucca Mountain and provides habitat for 12 species listed under the ESA, including the Devils Hole pupfish (*Cyprinodon diabolis)* and Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes).* Ash Meadows also provides aquatic and riparian habitat essential for other sensitive species of plants and invertebrates and for migratory and resident bird species. These and other wildlife species are dependent upon several free-flowing springs within the boundary of the refuge.

2... The NWPA requires DOE to provide reasonable assurance that the environment will be protected from the hazards posed by the Yucca Mountain repository. In order to meet this requirement, DOE has conducted numerous detailed analyses of Yucca Mountain's geology and hydrology for the past 15 years. Through these and other activities associated with site characterization, DOE has amassed a large body of evidence to support the likely determination that Yucca Mountain is the most suitable site to store the nation's high-level nuclear waste. Despite the fact that the most advanced technology is being utilized to design a foolproof waste barrier system for the repository and given the fact that the waste would remain radioactive for many thousands of years, we continue to be concerned that a facility of this nature inherently poses some degree of risk to wildlife resources. Our primary concerns are as follows:

Groundwater flows in aquifers below Yucca Mountain are generally to the south. Therefore, radionuclides and toxic chemicals, if introduced to the groundwater either by a short-term catastrophic event (e.g. earthquake, flood) or through long-term (i.e. >1,000 years) degradation of the waste storage containers, could eventually migrate to environmentally sensitive areas such as Ash Meadows NWR. A recent study found that the plutonium compound PuO2, once thought to be the most stable form of plutonium waste, can be oxidized by water making it more soluble and increasing the risk of groundwater contamination from storage facilities (Haschke et al. 2000).

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2 cont. We find these and other uncertainties associated with containment of high level radioactive waste to be cause for concer..

3 Transportation of high level radioactive waste to Yucca Mountain by truck or rail from nuclear facilities nationwide also has the potential to impact wildlife resources should a breach in containment occur. There is an inherent risk associated with transportation of any hazardous material. Although DOE has conducted detailed analysis of worst-case scenarios, even the best waste management strategies cannot predict every possibility. We understand that the radioactive waste would be transported in a virtually leak-proof stainless steel cask in the form of dry pellets which would make release of any waste material extremely remote. Nevertheless, there remains a potential environmental risk, albeit minuscule, at any given point along the proposed rail or highway transportation corridor.

4 Cumulative environmental effects from the future operation of the Yucca Mountain repository and past activities at the NTS are also of concern. Possible impacts to groundwater and spring discharges resulting from activities at NTS, approximately 25 miles north of Ash Meadows NWR, are being evaluated by DOE, the Service and the U.S. Geological Survey (USGS). Activities at the NTS which may have resulted in contamination of the region include both atmospheric and subterranean tests of nuclear devices and other tests involving radioactive materials, controlled atmospheric releases of numerous gaseous materials, and disposal and destruction of various types of solid and liquid wastes. The extent to which these activities have placed wildlife resources at risk is still under investigation. DOE's Environmental Management Program is focused on identifying the nature and extent of contamination from the nuclear weapons programs at DOE facilities. This process is underway at the NTS with ongoing environmental restoration and waste management activities.

ACCIDENTS

5 We agree with the DOE that a major accident involving a shipment of this material is of low probability with a level of general uncertainty, and therefore, is not quantified to be zero. Moving70,000 metric tons of high- level nuclear waste, including 50 metric tons of weapons grade materials, from sites that are almost entirely east of the Mississippi River, over a 100 year period, almost ensures that an accident will occur, sometime, somewhere. Testing has shown that conditions exist under which shipping casks can be penetrated or ruptured (page 6-33 of the EIS). It is not clear in the draft whether a head-on truck or train collisions and train derailments will produce such conditions but it is important that the final EIS address DOE's plans to contain or control such events and their impacts.

SABOTAGE

6 That there are devices already in existence that can penetrate the truck shipping casks (page 6-33 of the EIS) if used by saboteurs, must not be taken lightly. That the trains and trucks will be guarded solves part of the problem, but not entirely. It is presumed that the guards will be armed, but would that protect against an intentional derailment? If the act of sabotage is successful, how would DOE address response and cleanup or control?

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HIJACKING

7 We could find no mention, in the EIS, of the possibility of one of the trucks being hijacked. A hijacked truck could be driven anywhere and used as a threat. A hijacked trucks would be most vulnerable when they are stopped so that the guards and drivers can eat or sleep. How does DOE plan to address this situation?

RADIATION

8 If we are interpreting Table 4-34 (page 4-59) correctly, over a 70 year life span a person living within 12 miles of the repository would receive a life time radiation dose of between 38 to 100 millirems from the repository depending on the thermal load scenario used. Is this correct? If so, it is significantly lower than the NRC's standard of 100 millirems per year at abandoned mines after reclamation. We believe that it is unusual that a person residing near this repository would receive less radiation than would one who lived near many other areas containing less radiation, such as abandoned mine sites. If our interpretation is incorrect, and the correct dose rate is between 38 and 100 millirems per year, then the low thermal load matches the NRC standard. Perhaps this figure needs to be reevaluated in the final EIS to clear up this ambiguity.

CONFLICTS WITH EXISTING LAND USES

9 The need for rights of way across public lands to access the Yucca Mountain Facility could create conflicts with existing land uses in the area through traffic, construction, accidents and incidental spillage of nuclear materials containers. How will these be addressed?

SPECIFIC COMMENTS:

Draft Environmental Impact Statement, Summary.

10 **Page S-36, 5.4.1.3 Geology, first paragraph.**

Most of the faulting that affected Yucca Mountain occurred during the 11.4 to 14 Ma interval of volcanic activity and not subsequent to the activity, as stated in the text.

11 **Page S-36, 5.4.1.3 Geology, second paragraph.**

The correct name of the repository host rock is the Topopah Spring Tuff, not "Topopah Springs Formation" or "Topopah Springs formation."

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12 **Page S-37, 5.4.1.3 Geology, first paragraph.**

Point (3) states that the Topopah Spring Tuff was chosen because of ". . . its location away from major faults that could adversely affect the stability of underground openings. . ." This statement implies that the Topopah Spring Tuff is not intersected by major faults, which it most assuredly is. Faults cut through all of the Tertiary volcanic units in the proposed repository area, including the Topopah Spring Tuff. Solitario Canyon fault and several other known faults cut through the Topopah Spring Tuff, some immediately adjacent to the underground facilities.

The relationship between faulting and the selection criteria of the Topopah Spring Tuff as the repository host rock in the Summary and the Draft EIS itself (page 3-24) is unclear and needs more detailed and accurate explanation. The selection of Topopah Spring Tuff cannot be predicated on its lack of proximity to seismically active faults. If so, the site would not be viable. Clarification is needed.

13 **Page S-37, second paragraph.**

The statement, "The Solitario Canyon fault forms the major bounding fault on the west side of Yucca Mountain, and volcanic units in the mountain tilt eastward as a result of displacement along this and lesser faults through the mountain . . .," needs clarification. There are faults on the east side of Yucca Mountain. The faults that bound the eastern side of the proposed repository area, the Bow Ridge and Paintbrush Canyon faults, to name just two (see table 3-8, Characteristics of major faults at Yucca Mountain, v. 1 - Impact Analysis, Draft EIS), need to be mentioned here. Additionally, because these latter two north-trending faults dip to the west beneath the repository area and the adjacent material handling facilities that would be built at the north and south portals, understanding the seismic hazard potential of these faults is extremely important.

In addition, easterly tilts are not the result of movement on the Solitario Canyon fault and "lesser faults through the mountain." These tilts are the result of movement on a whole series of block-bounding faults, of which the Solitario Canyon fault is one.

Draft Environmental Impact Statement.

14 **Page 3-14, Section 3.1.3.1 Physiography (Characteristic Land forms).**

This section label and content are confusing. The unnumbered subsections on Site Stratigraphy and Lithology, Selection of Repository Host Rock, and Potential for Volcanism at the Yucca Mountain site should be numbered subsections under the main section 3.1.3, Geology, and not the subsection of Physiography, to which they have little relation.

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15 **Page 3-16, Site Stratigraphy and Lithology.**

The sedimentary history of the region including the Tertiary sedimentary rocks (for example Pavits Springs Formation) need to be discussed in this section and included in Table 3-6 (page 3-19).

16 "Paleozoic and Precambrian" need to be substituted for "pre-Cenozoic" in order to correspond with the wording in the referenced Table 3-6, page 3-19.

17 **Page 3-19, first paragraph.**

The "pre-Cenozoic" (see above) rocks are also exposed at Calico Hills and Striped Hills, which are as close or closer to Yucca Mountain than are the pre-Cenozoic rocks at Bare Mountain, and therefore should be included in the discussion.

For clarity, the borehole (first paragraph) should be described as 2 kilometers east of the crest of Yucca Mountain, because Yucca Mountain is physiographically defined as all the numerous ridges that surround the borehole.

18 **Page 3-21, last paragraph.**

The statement, "Volcanic rocks younger than the Tertiary units. . .," is incorrect. Most of the volcanic rocks are Tertiary in age, including the Skull/Little Skull lava flows, the lava flow at the south edge of Crater Flat, the 10 Ma basaltic dike, and the 3.7-Ma cones and flows in Crater Flat.

19... **Page 3-22, Figure 3-7, General bedrock geology of the proposed repository Central Block area.**

This figure is inaccurate and does not correctly correspond to Figures 3-8, 3-10, or the original geologic map (Day and others, 1998). The following changes and/or additions need to be made:

a. The configuration of the Drill Hole Wash fault needs to be mapped as shown in Figure 3-10.

b. The Ghost Dance fault needs to continue to the southwest and not abruptly terminate as shown is this Figure (see Figure 3-10).

c. The zone of intense faulting between the Bow Ridge and Ghost Dance faults is missing. This zone connects with the Dune Wash fault. These faults are shown in the cross-section (Figure 3-8).

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19 cont.

d. The small intra block faults need to be included in the Figure because the contacts are drawn incorrectly without them. Figure 3-8 cannot be reconciled with Figure 3-7 without these mapped faults.

e. For clarity, the cross-section line in Figures 3-7 and 3-8 should be named A-A', not B-B', because there is only one cross section on these maps.

f. Because no lower block is shown, the "upper block" text needs to be deleted from the "Proposed drift boundary" in the Legend.

20 **Page 3-23, Figure 3-8, Simplified geologic cross-section of Yucca Mountain, West to east.**

The mismatch of contacts between units, which appears as wiggles, is incorrect. The Figure needs to show these contacts correctly.

21 **Page 3-24, first paragraph, and Page 3-33, Flood Potential.**

Boulders as large as 2 meters in diameter, as well as sand, silt, and clay, are part of the alluvial deposits on these fans and stream beds. This boulder-size material has the potential for significant destructive force during the flash floods.

22 **Page 3-25, Section 3.1.3.2 Geologic Structure.**

Discussion of the occurrence of joints and fractures in the volcanic rock at Yucca Mountain is needed in this section, including mention of the geographic and stratigraphic distribution of fractures, and whether they are fault- and/or stratigraphically-controlled.

23 **Page 3-25, Section 3.1.3.2 Geologic Structure, second paragraph.**

"Major crustal compression" and "crustal extension" need to have an associated direction, such as "Major east-west crustal compression" and "east-west crustal extension."

Crustal compression is stated to have occurred between 350 and 50 Ma, but there is no evidence for east-west compression younger than about 100 Ma in this region.

24 Day and others 1996 should be changed to 1998, both here and in the References (page 12-8).

25... **Page 3-25, Section 3.1.3.2 Geologic Structure, fifth paragraph.**

It is stated here that the ". . . total estimated displacement on the most active block-bounding faults . . . during the past 1.6 million years is less than 50 meters. . . (Simonds and others, 1995)." This statement is from the Conclusion section of Simonds and others (1995) and is misleading

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25 cont. when taken out of context. All measurements of Quaternary (1.6 Ma to present) displacement on these faults range from 0 to 6 m with most displacement in the 1-2.5 m range, as reported in Table 2 of Simonds and others (1995). Reference Table 3-8 in this paragraph to help clarify this point.

26 **Page 3-25, Section 3.1.3.2 Geologic Structure, sixth paragraph.**

The statement, "The Solitario Canyon fault along the west side of Yucca Mountain is **the** major block-bounding fault . . .," is incorrect. The Solitario Canyon fault is one of numerous block-bounding faults that are shown on Figure 3-10. These include the Northern Windy Wash, Fatigue Wash, Solitario, Iron Ridge, Dune Wash Bow Ridge, Midway Valley, Paintbrush Canyon faults, just to name those within 4 km radius of the proposed perimeter of the repository.

27 **Page 3-25, Section 3.1.3.2 Geologic Structure, last paragraph.**

This short treatment of intra block faults (the subsidiary faults between the block bounding faults) places undue emphasis on NW-trending faults by discussing them first. Within the central block, where the repository would be sited, the intra block faults with the longest map traces and the largest amounts of displacement are the Ghost Dance Fault (splitting the center of the block) and the block-margin faults ("Imbricate Zone" of Scott, 1990) that are just west of the Bow Ridge Fault. Day and others (1998, USGS Map I-2601) and Scott and Bonk (1984) also document this. The NW- trending faults, such as the Sundance Fault, though characterized correctly, are relatively minor in comparison (Potter and others, USGS OFR 98-266, in press). It would be more appropriate to mention the much larger Ghost Dance fault first.

28 **Page 3-26, Figure 3-9, Types of geologic faults.**

For clarity, definitions of normal and reverse faults need to uniquely specify the correct sense of motion. For a normal fault reword the description, "dip-slip fault where one block has moved downdip relative to the other," to "dip-slip fault where the upper block has moved downdip relative to the lower block." For reverse fault, reword "dip-slip fault where one block has moved updip relative to the other" to "dip-slip fault where the upper block has moved updip relative to the lower block."

A diagram is needed for low-angle normal faults, such as in Calico Hills east, and Bare Mountain west, of Yucca Mountain.

29 **Page 3-27, Figure 3-10, Mapped faults at Yucca Mountain and in the Yucca Mountain vicinity.**

In the legend, the strike-slip fault symbol should have arrows showing relative sense of lateral motion (as on map), as well as an explanation of the strike-slip symbol. As it is, the legend only shows the dip-slip component on these faults.

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30 **Page 3-28, Table 3-8, Characteristics of major faults at Yucca Mountain.**

Define the late Quaternary in years for clarity.

31 **Page 3-29, Section 3.1.3.3 Modern Seismic Activity.**

The seismicity map with faults needs to be shown here as a numbered Figure.

32 **Page 3-30, fifth paragraph.**

The correct statement is that there is no observable strain measured *within the error of the data.*

33 **Page 3-30, Section 3.1.3.4 Mineral and Energy Resources.**

There is no discussion of energy resources in this section. The Yucca Mountain site is about 200 km SW of producing oil fields in Railroad Valley (one of two valleys in the state that have produced commercial oil). Published literature on the presence or absence of oil resources in the Yucca Mountain/NTS area include Chamberlain (1991 AAPG abstract), who suggested that Yucca Mountain is situated over a billion-barrel oil field, and Trexler and others (1996, AAPG Bulletin v. 80, no. 1), who disputed this, as did Grow and others (Hi-Level Waste Proceedings, 1994). Although it appears that there is a low potential for mineral and energy resources in the context of today's recovery technology, a discussion of the potential resources should be included here.

34 **Page 3-36, Section 3.1.4.2.1 Regional Groundwater.**

There is insufficient data to fully characterize the site-scale hydrology of the area. Because of the complexity of the geology and inconsistencies between the Large Hydraulic Gradient and thermal data, additional boreholes, appropriately configured, that penetrate to the Paleozoic carbonates beneath the Tertiary tuffs should be considered.

There is a lack of data on the hydrologic interaction between the Tertiary tufts and the underlying Paleozoic carbonate aquifers.

35 **Page 3-39 and Page 3-51, Section 3.1.4.2 Groundwater.**

The **range** of infiltration rates, hydraulic conductivities, etc. should be used rather than the average, especially in the case where the range is large. For example, apparent hydraulic conductivities range over 3 orders of magnitude (page 3-51). Also, the average infiltration rate of 6.5 mm/yr on page 3-39 is misleading because fracture systems allow much more rapid flow locally. The difficulty of Yucca Mountain hydrology is in the inability to predict which fractures or faults will act as highly transmissive zones. Care must be taken to show ranges of behavior so that best and worst case scenarios can both be evaluated.

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36 **Page 3-79, Section 3.1.8 Occupational and Public Health and Safety.**

The radiological hazards and their consequences were discussed in a concise way such that the average citizen can draw conclusions about the risks of the proposed and alternative actions. The background information that was provided to develop an understanding of ionizing radiation and the hazards/risks was especially helpful.

37 In summary, as DOE continues to further characterize the suitability of the proposed Yucca Mountain site in sufficiently isolating high-level radioactive waste and spent nuclear fuel, we look forward to continued coordination on protection of the Department's trust wildlife and other resources. The Service's Southern Nevada Field Office is interested and available to provide technical support in development and implementation of monitoring programs for Yucca Mountain operations. The Service's technical support can be integrated with ongoing groundwater monitoring programs by several other agencies in the vicinity of Yucca Mountain. DOE and USGS have collaborated since 1989 on the Environmental Monitoring Program in order to better understand the hydrology of this area. Monitoring is essential in our view and will help to ensure that any changes in the environment are detected and investigated appropriately. We look forward to working with the DOE on this important national initiative.

The Department appreciates the opportunity to review this DEIS. We hope our comments will be useful in evaluating the Yucca Mountain site for a geologic repository for the disposal of spent nuclear fuel and high-level radioactive waste. References are included on the following page.

Should you have any questions or wish to discuss our comments further, please do not hesitate to call Dr. Vijai N. Rai of this Office at (202)208-6661.

Sincerely,

Willie R. Taylor
Director
Office of Environmental Policy
and Compliance

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RESPONSES TO U.S. DEPARTMENT OF THE INTERIOR COMMENTS ON THE DRAFT EIS (Comment Document 1969)

1. On December 17, 1998, DOE requested a species list from the U.S. Fish and Wildlife Service and initiated consultation to evaluate whether the Proposed Action could affect the threatened desert tortoise or protected species at Ash Meadows, Devils Hole, or along transportation corridors. In a Biological Assessment submitted to the U.S. Fish and Wildlife Service on April 24, 2000, DOE concluded that the Proposed Action would not affect the listed species in the Ash Meadows or Devils Hole areas because these areas are in a different regional groundwater sub-basin from Yucca Mountain. The Fish and Wildlife Service concurred with this conclusion during consultation on the effects of repository construction, operation and monitoring, and closure on threatened and endangered species (see the Fish and Wildlife Service Final Biological Opinion in Appendix O of the EIS). Furthermore, there are no playas in the vicinity of Yucca Mountain where surface water could accumulate and attract migratory birds. The playa at Frenchman Flat is located approximately 35 kilometers (22 miles) east of Yucca Mountain and would be unaffected by the Proposed Action.

   DOE did determine that the Proposed Action could affect the desert tortoise and consequently has proposed mitigation measures to minimize effects. If the Secretary of Energy recommends approval of the Yucca Mountain site to the President, and Yucca Mountain is ultimately authorized for the disposal of spent nuclear fuel and high-level radioactive waste, DOE would implement all reasonable and prudent mitigation measures and comply with the terms and conditions of the Final Biological Opinion from the U.S. Fish and Wildlife Service. See Appendix O of the EIS for the Opinion.

   The Desert National Wildlife Range, approximately 48 kilometers (30 miles) east of the repository, would be unaffected by the Proposed Action unless the Valley Modified Corridor, which could be on, or adjacent to, the southern boundary of the Range, was selected. With regard to the transportation implementing alternatives in the State of Nevada, DOE believes this EIS is sufficient for the determination of the relative merits and a selection decision among the various corridors and shipment modes discussed in the EIS, but acknowledges additional environmental review would be required to assess the potential impacts of specific route alignment within a corridor. DOE would continue discussions with the U.S. Fish and Wildlife Service pursuant to Section 7 of the Endangered Species Act, as amended, on any corridor or alignment within a corridor determined to require further environmental review and would implement the terms and conditions of any subsequent Biological Opinions.

2. DOE believes that the comments expressed by the U.S. Fish and Wildlife Service concerning risks to wildlife resources are addressed in the EIS. Section 4.1.8 of the EIS discusses the potential for catastrophic events (including earthquakes) occurring at the Yucca Mountain Repository during construction, operation and monitoring, and closure of the repository, and the consequences of these events. As described in Section 4.1.3, flooding would be unlikely to release contaminants because the design of critical surface facilities would withstand the most severe reasonably possible floods. Chapter 5 discusses impacts from the long-term performance of the repository. The evaluations included impacts from volcanic (Section 5.7.2) and seismic disturbances, as well as impacts from the slow degradation of waste packages over thousands of years. This slow degradation has the highest potential to spread contaminants as they are leached into the groundwater beneath Yucca Mountain.

   Section 3.1.4.2.1 of the EIS shows that the flow path of groundwater from Yucca Mountain extends to Jackass Flats and the Amargosa Desert, and continues southward to the primary point of discharge at Franklin Lake Playa in Alkali Flat. The EIS recognizes that some groundwater reaching this far might bypass Franklin Lake Playa and continue into Death Valley. The EIS also recognizes that a fraction of the groundwater that reaches the Amargosa Desert might flow through the southeastern end of the Funeral Mountains to springs in the Furnace Creek Wash in Death Valley National Park. The springs in Ash Meadows (including Devils Hole) are not along the groundwater flow path from Yucca Mountain. As described in Section 3.1.4.2.1, groundwater beneath Yucca Mountain flows to the Amargosa Desert but does not discharge in Ash Meadows. From Ash Meadows to the low axis (Carson Slough) of the Amargosa Desert, the groundwater table declines

about 64 meters (210 feet), indicating that the groundwater flows from Ash Meadows toward the Amargosa Desert, not the other way around.

Chapter 5 of the EIS does not specifically address the risks to people and natural resources in Death Valley National Park from the use and consumption of groundwater. However, it clearly indicates that risks would decrease with increased distance from the repository. Accordingly, impacts to the Park, because it is far from Yucca Mountain, would be negligible.

In Section 5.3 of the EIS, DOE concluded that the predicted long-term levels of radionuclide concentrations in groundwater and the resulting dose levels at the predicted discharge area in Amargosa Valley would be low. As a consequence, DOE does not expect that the dose rates to plants and animals would cause measurable detrimental effects in populations of any species because the rates would be less than 100 millirad per day. The International Atomic Energy Agency concluded that chronic dose rates of much less than 100 millirad per day are unlikely to cause measurable detrimental effects in populations of even the more radiosensitive species in terrestrial ecosystems (DIRS 103277-IAEA 1992). The DOE interim technical standard, *A Graded Approach for Evaluating Dose to Aquatic and Terrestrial Biota*, which the Department made available for interim use on July 20, 2000, contains more information about potential effects of radiation on biota.

The comment also refers to a recent laboratory finding that a species of plutonium oxide has a higher solubility than the species most often considered to be the normal oxidized form of the metal (plutonium dioxide) (DIRS 150367-Haschke, Allen, and Morales 2000). Scientists working on the Yucca Mountain Project are aware of this finding. DOE believes that the finding is within the range of conservatisms built into the plutonium solubility model used to model the long-term performance of the repository.

3. DOE agrees that a release of hazardous materials during accidents involving spent nuclear fuel or high-level radioactive waste would be very unlikely. With regard to the potential impacts to wildlife resources, a transportation accident could result in the dispersal or death of individual members of a species within a localized area but would be unlikely to have long-term detrimental effects upon a population as a whole.

4. This comment accurately summarizes some of the issues involving the potential cumulative impacts associated with the Proposed Action and some of the ongoing evaluations being conducted by the Department and other agencies, including the U.S. Fish and Wildlife Service. In preparing Chapter 8 of the EIS, the Department reviewed many past, present, and reasonably foreseeable future actions to determine where there was potential for cumulative impacts. Chapter 8 of the EIS describes both the short-term and long-term impacts of the proposed repository, along with transportation and manufacturing cumulative impacts.

5. The shipping casks used to transport these spent nuclear fuel and high-level radioactive waste are massive and tough with design features that comply with strict regulatory requirements that ensure the casks perform their safety functions even when damaged. Numerous tests and extensive analyses have demonstrated that casks would provide containment and shielding even under the most severe kinds of accidents. In addition, since the publication of the Draft EIS, the Nuclear Regulatory Commission published *Reexamination of Spent Fuel Shipment Risk Estimates* (DIRS 152476-Sprung et al. 2000). Based on the revised analyses, DOE has concluded in the EIS that casks would continue to contain spent nuclear fuel fully in more than 99.99 percent of all accidents (of the thousands of shipments over the last 30 years, none has resulted in an injury due to release of radioactive materials). This means that of the approximately 53,000 truck shipments, there would be an estimated 66 accidents, each having less than a 0.01-percent chance that radioactive materials would be released. The chance of a rail accident that would cause a release from a cask would be even less. The corresponding chance that such an accident would occur in any particular locale would be extremely low. Section J.1.4.2.1 of the EIS presents consequences for accidents that could release radioactive materials.

With regard to the containment or control of accident events, DOE would rely on a number of actions including the training of public safety officials and the implementation of safeguards and security plans. Section 180(c) of the NWPA requires DOE to provide technical assistance and funds to states for training public safety officials and appropriate units of local government and tribes through whose jurisdictions DOE

shipments would pass. DOE anticipates financial and technical assistance to eligible jurisdictions to begin at least 4 years before the commencement of shipments to the repository.

Concerning safeguards and security plans, DOE would comply with all requirements of 10 CFR Part 73, including preshipment planning, communications, armed escorts and tamper-indicating devices on shipping casks. Regarding shipment routes, pursuant to U.S. Department of Transportation regulations, 49 CFR 397.101 and DIRS 154766-NRC (1980), added protection would be afforded by the selection of routes which exhibit certain criteria including the likelihood of swift law enforcement response, avoidance of tactically disadvantageous locations such as long tunnels or bridges spanning heavily populated areas, and flexibility to adjust schedules to accommodate unexpected situations.

6. Transportation shipments would be protected from sabotage. The Nuclear Regulatory Commission has developed a set of rules specifically aimed at protecting the public from harm that could result from sabotage of spent nuclear fuel casks. Known as physical protection or safeguards regulations (10 CFR 73.37), these security rules are distinguished from other regulations that deal with issues of safety affecting the environment and public health. The objectives of the safeguards regulations are to minimize the possibility of sabotage and facilitate recovery of spent nuclear fuel shipments that could come under control of unauthorized persons.

   Cask safety features that provide containment, shielding, and thermal protection also provide protection against sabotage. The casks would be massive. The spent nuclear fuel in a cask would typically be only about 10 percent of the gross weight; the remaining 90 percent would be shielding and structure.

   Although it is not possible to predict the types of potential sabotage events with certainty, DOE has examined various accident scenarios, which can provide a sense of the consequences that could occur in such events. In addition, DOE has specifically analyzed the potential consequences of sabotage against a truck or rail cask. The results of this analysis indicate that the maximally exposed individual would increase the risk of incurring a fatal cancer from approximately 23 percent (the current risk of incurring a fatal cancer from all other causes) to about 29 percent. The same event could cause 48 latent cancer fatalities in an assumed population of a large urban area.

   Because of the attacks on September 11, 2001, the Department and other agencies are reexamining the protections built into their physical security and safeguards systems for transportation shipments. As dictated by results of this reexamination, DOE would modify its methods and systems as appropriate.

   In response to public comments, DOE has included a discussion on the range of potential costs of cleanup following a severe transportation accident in Appendix J of the EIS. This discussion reviews calculations of land area contaminated and costs for cleanup presented in past studies, including a report used in the 1986 Environmental Assessments (DIRS 154814-Sundquist et al. 1985), and information submitted by the State of Nevada in its comments on the Draft EIS. The information submitted by the State included estimates of cleanup costs as high as $270 billion. Cost data used in the studies reviewed in Section J.1.4.2.5 included data compiled from case studies involving actual cleanup of radioactive materials contamination. Section J.1.4.2.5 discusses environmental restoration after a release of radioactive material.

7. Transportation shipments would be protected from sabotage. The Nuclear Regulatory Commission has developed a set of rules specifically aimed at protecting the public from harm that could result from sabotage of spent nuclear fuel casks. Known as physical protection or safeguards regulations (10 CFR 73.37), these security rules are distinguished from other regulations that deal with issues of safety affecting the environment and public health. The objectives of the safeguards regulations are to minimize the possibility of sabotage and facilitate recovery of spent nuclear fuel shipments that could come under control of unauthorized persons.

8. The interpretation is correct. In the Draft EIS, the maximally exposed individual would receive an estimated dose of 38 to 100 millirem over 70 years. Table 4-35 (Footnote c) and Section 4.1.7.5.3 of the Draft EIS explain this dose. Section 4.1.2 of the EIS discusses the highest potential annual dose would be less than 2 millirem per year.

Exposure scenarios at reclaimed uranium mines or mills are much different from the potential exposure near the proposed repository at the Yucca Mountain site. The key differences at Yucca Mountain would be the lack of high uranium and uranium decay product source material, lack of tailings with enhanced concentrations of uranium decay chain radionuclides, and the location of the potential public dose receptor at the boundary of the controlled area (15 millirem per 40 CFR Part 197). Further, potential public exposures at Yucca Mountain would be held to a much more rigorous standard than 100 millirem per year. The discussions in Sections 4.1.2 and 4.1.7, along with the supporting information in Section G.2, explain potential public radiation doses.

9. Sections 6.3.1, 6.3.2, and 6.3.3 of the EIS address the potential impacts of Nevada legal-weight truck, heavy-haul truck, and branch rail line implementing alternatives, respectively, including land-use impacts. These sections recognize and describe the impacts related to construction and operation of branch rail lines and developing or upgrading highways, including traffic impacts. Section 6.2.4.2 addresses impacts from accidents, including spills.

   DOE acknowledges that some land-use conflicts could be inevitable during the construction and operation of a transportation corridor for the Yucca Mountain Repository. The implementing alternatives for transportation described in the EIS were based in part on attempts to avoid or minimize potential land-use conflicts.

   DOE has identified mostly rail as its preferred mode of transportation, both nationally and in Nevada. At this time, however, the Department has not identified a preference among the five candidate rail corridors in Nevada. Should the branch rail line implementing alternative be selected and a preferred rail corridor identified, additional engineering and environmental studies would be conducted as a basis for detailed design and for appropriate National Environmental Policy Act reviews. During this process, DOE would initiate consultations with responsible local, State, Federal, and tribal agencies, landowners, and other stakeholders to identify, acquire, and evaluate additional information and develop mitigative actions necessary to minimize potential impacts, including land use.

10. DOE agrees that most of the faulting occurred during this period and Section S.4.1.3 of the EIS Summary has been changed to, "Yucca Mountain is a product of volcanic and seismic activity that occurred 14 million to 11.5 million years ago."

11. DOE has corrected the name of the repository host rock to "Topopah Spring Tuff."

12. DOE agrees that it cannot predicate its selection of the Topopah Spring Tuff for the repository on the lack of proximity to seismically active faults. The Department has changed the statement in the Summary and Section 3.1.3 of the EIS to indicate that it chose the repository emplacement area because of its location away from major faults that could adversely affect the stability of underground openings.

13. The comment is correct that the Solitario Canyon fault is not the only block-bounding fault identified in the EIS. However, DOE did not modify the text of the Summary in order to keep it understandable to a wide range of readers. DOE has, however, clarified the text in Section 3.1.3.2 of the EIS, which also refers readers to numerous reference materials on the subject.

14. The purpose of Section 3.1.3.1 is to provide a broad overview of regional and site geology. The purpose of the subsections that are part of Section 3.1.3.1 is to address specific issues of particular concern or interest to the public (such as faulting and seismic activity) or that are a definite change of topic (for example, mineral and energy resources). DOE agrees that it could put the topics identified in the comment in separately numbered sections, but made an editorial decision not to do so.

15. Although the EIS is concerned with the sedimentary history of the region and sedimentary rock units at Yucca Mountain, the main focus is on those units important for the study of groundwater infiltration, flow, and transport. Table 3-6 is highly generalized and identifies only the Topopah Spring Tuff, the repository host rock, by name. The commenter is referred to other parts of Section 3.1.3 of the EIS that describe the

history and stratigraphy of the Yucca Mountain area, and to Table 3-7, which describes the Tertiary rock units at Yucca Mountain in more detail than Table 3-6.

16. DOE has revised the text of Section 3.1.3.1 of the EIS such that the parenthetical explanation "(that is, Paleozoic and Precambrian)" follows the reference to Pre-Cenozoic.

17. This comment is correct. DOE has revised Section 3.1.3.1 of the EIS to include the exposures at Calico Hills and Striped Hills.

18. DOE has revised Section 3.1.3.1 of the EIS to state that volcanic rocks younger than Tertiary age pertain only to the four northeast-trending cinder cones in the center of Crater Flat, dated at about 1 million years old, and the Lathrop Wells basaltic cinder cone, dated at 70,000 to 90,000 years old.

19. DOE has updated the general bedrock geology figure in Section 3.1.3.1 in the EIS as described in the comment to show additional faults in the repository block area. The figure is now consistent with the simplified geologic cross-section figure that follows it.

    This comment suggested that the cross-section line in these figures should be named A-A', not B-B'. DOE has made this modification.

    DOE provided the upper block label in the figure to help the reader identify the area shown because the EIS discusses other blocks.

20. The maps in Chapter 3 of the EIS depicting fault information are simplified and show only selected faults. However, DOE has added more faults to the general bedrock geology in Section 3.1.3.1 to make it more consistent with the cross-section figure that follows.

21. Section 3.1.3 of the EIS has been changed to indicate that the alluvial deposits on fans and in stream beds includes boulders, cobbles, pebbles, sand, silt and clay; Section 3.1.4.1.2 has been modified to indicate that mud flows may include boulder-size material.

22. DOE has modified the discussion in Section 3.1.3.2 of the EIS. The faults described are well-defined structures; joints, along which there is no appreciable movement, also occur in the rock units mapped at the site. Within the Paintbrush Group (Tiva Canyon, Yucca Mountain, Pah Canyon, and Topopah Spring tuffs), joints have been subdivided into three groups based on how they developed and their approximate time of origin: early cooling joints, later tectonic joints, and joints due to erosional unloading (DIRS 151945-CRWMS M&O 2000). Each group of joints exhibits specific characteristics with respect to joint length, orientation, and connectivity. The cooling and tectonic joints have similar orientations (generally trending north-south), whereas cooling joints include irregularly spaced horizontal joints as well. Joints that developed from erosional unloading are variably oriented but trend predominantly east to west, perpendicular to the cooling and tectonic joints. Tectonic joints occur throughout the Paintbrush Group; cooling joints occur in each of the welded units. In general, the Tiva Canyon tuff and the Topopah Spring tuff have the highest joint frequencies and joint connectivities. The nonwelded Yucca Mountain tuff and the Pah Canyon tuff have the fewest joints. Geologic, geoengineering, and hydrologic aspects of fractures are discussed in detail in the *Yucca Mountain Site Description* (DIRS 151945-CRWMS M&O 2000). DOE has added to Section 3.1.3.2 of the EIS more information about joints and fractures in the volcanic rock at Yucca Mountain.

23. The text in Section 3.1.3.2 has been modified to indicate that major east-west crustal compression occurred periodically in the Great Basin between about 350 million years ago to about 65 million years ago. This compression moved large sheets of older rock great distances upward and eastward over younger rocks to produce mountains. References to support this discussion include Armstrong (DIRS 101583-1968), Fleck (DIRS 150625-1970), CRWMS M&O (DIRS 100127-1998), and Dunne (DIRS 102861-1986).

24. DOE has updated the subject reference.

25. DOE has clarified this paragraph in Section 3.1.3.2 of the EIS, as suggested by the comment.

26. The comment is correct; text in Section 3.1.3.2 has been revised for clarity. The Solitario Canyon fault is not the only block-bounding fault identified.

27. DOE has reorganized the paragraph in question to discuss the Ghost Dance fault, which occurs in the middle of the repository block, before discussing the northwest-trending faults.

28. The description of faults in Figure 3-9 of the Final EIS has been clarified.

29. DOE has changed the legend on the mapped faults figure in Section 3.1.3.2 to label the arrows in the figure as strike-slip faults.

30. DOE believes that it has made the table in Section 3.1.3.2 of the EIS more accurate by removing the word "late" from the column heading related to Quaternary displacement.

31. During EIS preparation, DOE decided to omit a seismicity map in favor of a simpler presentation. The Department made this decision with the understanding that more detailed seismic information is available in the *Yucca Mountain Site Description* (DIRS 151945-CRWMS M&O 2000). With regard to showing faults on a seismic map, seismic events do not correlate with mapped surface traces or Quaternary faults, as indicated in Section 3.1.3.3 of the EIS.

32. DOE believes the paragraph is correct as written. The main point of this paragraph is that the strain rate is significantly less than the rate reported by Wernicke et al. (DIRS 103485-1998), which did not account for the coseismic and postseismic effects of the 1992 Little Skull Mountain earthquake.

33. The EIS presents the results of various investigations on mineral and energy resources. DOE considers the likelihood of finding oil or gas to be low in the vicinity of the proposed repository. Drilling of numerous boreholes to depths beyond 1829 meters (6,000 feet) in the area found no indications or shows of oil of gas. Therefore, DOE decided not to include a detailed discussion of mineral and energy resource potential in the EIS, but rather to refer the reader to the numerous references that discuss these issues. This approach is consistent with the regulations of the Council on Environmental Quality [40 CFR Part 1501.7(a)(3)] that direct agencies to identify and eliminate from detailed study those issues which are not significant.

34. DOE, in cooperation with Nye County, has initiated a program (called the Early Warning Drilling Program) to characterize further the saturated zone along possible groundwater pathways from Yucca Mountain, as well as the relationships among the volcanic, alluvial, and carbonate aquifers. Information from the ongoing site characterization program and from the performance confirmation program (if Yucca Mountain is approved for a repository), would be used in conjunction with that of the Early Warning Drilling Program to refine the Department's understanding of the flow and transport mechanics of the saturated alluvium and valley-fill material south of the proposed repository site, and to update conceptual and numerical models used to estimate waste isolation performance of the repository. When DOE published the Draft EIS, only limited information from the Early Warning Drilling Program was available. Since then, however, this program has gathered additional information (see Section 3.1.4.2.1 of the Final EIS).

35. The EIS describes why the quantity of water moving through the proposed repository would be small compared to other sources of recharge in the region and to the amount of groundwater moving through the area. DOE believes that presenting ranges of infiltration rates in this case would add unnecessary complexity. More information, including temporal and spatial ranges of net infiltration, is in the Water Source and Movement discussion in Section 3.1.4.2.2 of the EIS.

    DOE disagrees that description of an average net infiltration over the area of the repository is misleading. (It should be noted that the EIS now presents a different infiltration estimate due to the results of an updated infiltration study.) The EIS also considers smaller areas of higher and lower infiltration. Section 3.1.4.2.2 identifies infiltration rates over an order of magnitude higher in areas where thin alluvium overlies highly permeable rock. It would be misleading to imply that these higher infiltration rates occur over large areas.

DOE agrees that it is difficult to predict which fractures or faults would act as highly transmissive zones. However, much has been learned from studies, particularly chlorine-36 studies, that have suggested a correlation between subsurface locations where there is evidence of "fast pathways" (less than 50 years) and physical conditions in the mountain and on the surface. The Water Source and Movement discussion in Section 3.1.4.2.2 describes these correlations.

36. Thank you for your comment.

37. DOE acknowledges and appreciates the offer of technical support from the U.S. Department of the Interior and its individual bureaus on the Yucca Mountain Project monitoring programs. Such cooperation will inevitably increase the knowledge base on the local environment and help ensure minimal impacts of the Proposed Action on regional wildlife and other natural resources.

010066

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Washington, D.C. 20240
http://www.blm.gov

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In Reply Refer To:
1793 (360)

Ms. Carol M. Borgstrom
Director, Office of NEPA Policy and Compliance
U.S. Department of Energy
Washington, D.C. 20585

Reference: U.S. Department of Energy's (DOE) Supplement to the Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada

Dear Ms. Borgstrom:

1 Thank you for the opportunity to review the above-referenced supplement to the Draft Environmental Impact Statement (EIS) for the proposed radioactive waste repository at Yucca Mountain. At this time, this Office does not have the technical expertise to evaluate the nature of the environmental impacts that may be expected from the modified design compared to the Draft EIS. If you should have any questions, please contact Andrea McLaughlin of my staff at (202) 452-7717.

Sincerely,

B.R. Hyde, Jr.
Manager, Protection and Response Group

cc: Willie R. Taylor, Director, Office of Environmental Policy and Compliance
Robert Anderson, Deputy Assistant Director, Minerals, Realty, and Resource Protection

MAY 22 2001

EH-42 (1)

RESPONSES TO U.S. DEPARTMENT OF THE INTERIOR COMMENTS ON THE SUPPLEMENT TO THE DRAFT EIS (Comment Document 10066)

1. Thank you for your reply.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

EIS001632

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OFFICE OF
ENFORCEMENT AND
COMPLIANCE ASSURANCE

February 11, 2000

Ms. Wendy R. Dixon
EIS Project Director
Office of Civilian Radioactive Waste Management
Yucca Mountain Site Characterization Office
P.O. Box 30307, M/S 010
North Las Vegas, NV 89036-0307

Dear Ms. Dixon:

In accordance with the National Environmental Policy Act (NEPA), Section 309 of the Clean Air Act, and the Council on Environmental Quality's implementing regulations (40 CFR 1500-1508), the Environmental Protection Agency (EPA) is providing you comments on the Draft Environmental Impact Statement (EIS) for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada, dated July 1999 (DOE/EIS-0250D, CEQ# 990282).

The Proposed Action addressed in the draft EIS is to construct, operate, monitor, and eventually close a geologic repository at Yucca Mountain in southern Nevada for the disposal of spent nuclear fuel and high-level radioactive waste currently in storage at 72 commercial and five Department of Energy (DOE) sites across the nation.

As outlined in this letter and accompanying detailed comments, EPA is seeking a number of clarifications about and additional data on the environmental impacts of the proposed project. We expect that DOE will be able to provide this information and enable EPA to fully assess the project's impacts. EPA is therefore rating the Yucca Mountain EIS as "EC-2", Environmental Concerns-Insufficient Information. EPA's major issues are summarized below, and our detailed comments are enclosed.

1 EPA commends DOE for what is generally a well-organized and plain English document
2... on a highly complex subject. However, EPA could not always find data or explanations to support the conclusions drawn. A prime example of this is that EPA found insufficient data to support the prediction of the movement of radionuclides in the saturated zone beneath the repository. These data are needed to determine if the facility's performance will satisfy applicable radiation standards designed to protect ground water resources and public water

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2 cont. supplies. As you know, EPA has proposed standards applicable to Yucca Mountain.

The draft EIS acknowledges that on-going studies at the proposed repository site and the continuing investigations of engineered barriers and waste package designs are not scheduled to be completed until after the submission of the final EIS. The continuing site characterization and data collection raise questions about whether a supplemental environmental impact statement will be needed once the final design and waste content are determined. CEQ regulations (sec. 1502.9) require a supplement to a draft or final EIS when there are substantial changes to a proposed action relevant to environmental concerns or where there are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impact.

If the Department's subsequent analysis of design choices indicates that the draft EIS/final EIS bounded the potential impacts, a supplemental draft and/or final EIS may not be needed. However, even if not strictly required by NEPA, a supplemental EIS or another document subject to public review and comment may be advisable given the potentially significant changes in final design and waste content. At a minimum, the final EIS must describe the changes from the draft EIS and update the discussion of impacts on the environment and public health. Our detailed comments provide examples of areas of uncertainty which lead to this conclusion.

3... EPA devoted considerable attention to the no-action alternatives and noted the public controversy about how realistic these are. EPA agrees that aspects of the no-action alternatives are speculative. However, the agency also believes that they provide a basis for comparison with the preferred alternative for the purposes of NEPA. We caution DOE, however, that should the U.S. decide not to proceed with constructing and operating the repository at Yucca Mountain and to pursue another solution, DOE would need to do a full examination of alternatives and their environmental impacts, within the confines of any national legislation.

EPA's review also focused on the national transportation aspects of this project. EPA appreciates that the actual shipments of waste will not likely occur for another 10 years and understands DOE's reluctance to provide additional information on routes for waste transport. However, EPA sees no reason why DOE cannot commit to making this information available as the time for shipments approaches, as the Department is doing now for shipments to the Waste Isolation Pilot Plant in New Mexico. Once DOE has greater certainty about the routes along which waste shipments will travel, the Department will also be able to update and expand upon, if needed, the environmental justice or other route-specific impact analyses. Specifically with regard to tribal governments, EPA encourages DOE to conduct a comprehensive tribal consultation process wherever waste shipments may cross tribal lands.

In addition, EPA suggests that the final EIS provide a section which lays out the responsibilities of various federal, state, local and tribal agencies in regulating, approving and monitoring shipments of radioactive waste. This information should provide additional

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assurance to the public that a national network of controls is in place designed to ensure public safety.

Thank you for the opportunity to review this document. If you have any questions or would like to meet to discuss our comments further, please contact Susan Absher of my staff. She may be reached at 202/564-7151.

Sincerely,

Richard E. Sanderson
Director
Office of Federal Activities

Enclosures: 2
Summary of Rating Definitions
Detailed EPA comments on the draft EIS

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DETAILED EPA COMMENTS on
Draft EIS for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain
(DOE/EIS-0250D, July 1999)

Section 1. Purpose and Need for Agency Action

4 Section 1.2.3, page 1-7. The second full paragraph describes the treatment process for high-level waste from storage in waste tanks through solidification. Part of that process "ordinarily includes separation of the waste into high-activity and low-activity fractions." However, after describing what happens to the "high-activity fraction," there is no mention of what happens with the "low-activity fraction." The low-activity fraction is still high-level waste, and this discussion should include the disposition of the low-activity fraction.

Section 2. Proposed Action and No-action Alternative

No-Action Alternative

3 cont. Section 2.2, page 2-59: This section describes the no-action alternative (no further site characterization at Yucca Mountain) and lays out two scenarios for this alternative: (1) wastes are stored at current locations and monitored/maintained for 10,000 years; or, (2) wastes are maintained for only 100 years, after which they are assumed to be abandoned. The Draft EIS acknowledges (page 2-60) that should there be a decision not to proceed with the repository, neither of these scenarios is likely; rather, the scenarios were chosen to provide a basis of comparison with the proposed action.

EPA agrees that while aspects of the no-action alternatives are speculative, they do provide a basis for comparison with the preferred alternative for the purposes of NEPA. We caution DOE, however, that should the U.S. decide not to proceed with constructing and operating the repository at Yucca Mountain, DOE would need to do a full examination of alternative solutions and their environmental impacts, within the confines of any national legislation.

Evolving Design of the Repository: General Comments

5... Page 2-6 indicates that there are many uncertainties about the final design of the repository and several of its components:

> "This EIS describes and evaluates the current preliminary design concept for repository surface facilities, subsurface facilities and disposal containers."
>
> "Plans for the repository would continue to evolve during the development of the final repository design and as a result of the NRC licensing review."
>
> "For these reasons, DOE developed implementing alternatives and analytical scenarios to bound the environmental impacts likely to result from the Proposed Action."

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5 cont. Page 2-10 states:

> "DOE continues to investigate design options . . . for final repository design; Appendix E identifies design features and alternative design concepts that DOE is considering for the final design (for example, smaller waste packages, a waste package design using two corrosion-resistant materials . . .). . . . DOE has assessed each of the design options still being considered for the expected change it would have on short- and long-term environmental impacts and has compared these impacts to the potential impacts determined for the packaging, thermal load and transportation scenarios evaluated in the EIS. . . DOE has concluded that the analytical scenarios and implementing alternatives evaluated in this EIS provide a representational range of potential environmental impacts the Proposed Action could cause."

The continuing site characterization and data collection raise questions about whether a supplemental environmental impact statement (SEIS) is needed once the final design and waste content are determined. CEQ regulations (sec. 1502.9) require a supplement to a draft or final EIS when there are substantial changes to a proposed action relevant to environmental concerns or where there are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impact.

If the Department's subsequent analysis of design choices indicates that the draft EIS/final EIS bounded the potential impacts, a supplemental may not be needed. However, even if a supplemental is not strictly required by NEPA, a supplemental or other document subject to public review and comment may be advisable given the potentially significant changes in final design and waste content. At a minimum, the final EIS must describe the changes from the draft EIS and update the discussion of impacts on the environment and public health. Examples of areas of uncertainty which lead to this conclusion are given below in the comments referring to pages 2-6, 2-10, 2-32, 2-37 (Section 2.1.2.4), and 2-81.

Evolving Design of the Repository: Specific Comments

6 Page 2-6, final two paragraphs of 2.1.1: The repository performance and dose assessments in the draft EIS are based on models and assumptions in the DOE Viability Assessment Report (DOE/VA - DOE/RW-0508) that are now outdated. For example, the draft EIS analyzes the Module I & II inventory increases which were not part of the DOE/VA. Also, the DOE/VA examined the performance of a waste package design that is now obsolete. The assessments in the final EIS should describe/assess the new EDA II design, particularly those aspects of the new design that modify the performance assessment.

7 Page 2-17, Figure 2-10 does not identify the proposed locations for the cask maintenance facility and landfill. Locations of these need to be identified in order to assess their potential impacts.

8... Page 2-21, 2.1.2.1.5: The second paragraph mentions "water used for cooling tower operations." We found no other description or reference to a cooling tower. The final EIS should explain the purpose of this operation and any possible radiological or chemical contamination from the

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8 cont. cooling tower.

9 Page 2-31: The third full paragraph describes removing materials from the repository during subsurface construction that occurs simultaneously with waste emplacement. What plans does the Department have for monitoring the water and other material being removed during waste emplacement operations? Monitoring should ascertain that no radioactive contamination is being removed. While it is not likely that such contamination will occur, there is always the possibility of contaminants adhering to the surface of waste packages and getting into the water or material being removed, or of an accident occurring.

10 Page 2-32: The second paragraph contains a general description of the waste package used for the performance assessment. The description of the waste package must be updated in the Final EIS.

11 Page 2-37, Section 2.1.2.3. In the final paragraph, the statement that DOE would use institutional controls "to limit or prevent intentional and unintentional activities in and around the closed repository" is problematic. EPA and the National Academy of Sciences maintain that prevention of such activities, including intrusion into the repository, cannot be assumed once active controls are discontinued. Since this paragraph refers to time beyond any reasonable active control period, e.g., more than 100 years, it should be amended to read "to attempt to limit intentional and

12 unintentional activities...." Second, this paragraph states, "Provisions could be added for post-closure monitoring." The final EIS should elaborate on when and how DOE would add post-closure monitoring.

13 Page 2-37, Section 2.1.2.4, first paragraph: When does the Department expect to have a performance confirmation program in place, and how will DOE decide which data to evaluate? We note that this paragraph says that the "performance confirmation programs could include" the listed data types. [emphasis added] EPA recommends using all of these factors to improve the performance assessment.

14 Page 2-40, Section 2.1.3.2, first paragraph: Please confirm whether only heavy-haul trucks will be used from commercial sites, or if legal-weight trucks may also be used.

90 Page 2-58, Section 2.1.4.3: This discussion does little to help the reader understand the design features and alternatives that affect operations and costs. We note that DOE intends to "evaluate the environmental impacts associated with the updated design in the final EIS." This section should be revised to clarify the discussion.

15... Page 2-58, Section 2.1.5: The discussion of "estimated costs" provides broad cost categories without an explanation of how these were derived. Also, there is no indication of how costs occur over time; no indication of the discount rate used to present all costs in 1998 dollars; and no indication of whether these are all direct costs of construction or if they include indirect costs such as that for siting the repository. TRW 1999e, the draft EIS cost summary report, is cited, but the final EIS should provide the reader more detail on costs.

Page 2-67, Section 2.2.3: The comments for section 2.1.5 apply here also. In addition, Table 2-6

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15 cont. provides only limited information and leaves out how storage costs were developed and how these compare to industry estimates.

16 Page 2-74, Section 2.4.3, first paragraph: The last sentence indicates that long-term (100 to 10,000 years) impacts were assessed only where DOE "could establish estimates of impacts." Were there any important impacts which were not assessed for this reason? If so, how does DOE plan to address them? (See 40 CFR § 1502.22)

17 Page 2-80, Table 2-8: It appears that the dose equivalent listed in this table for the maximally exposed member of the public (2.4 rem) is an annual value. If so, EPA assumes this value is listed in error. While EPA does not have transportation standards, compare this value to the limit for exposure to individuals of 0.015 rem per year (40 CFR Part 191) during the post-closure period of a repository.

18 Page 2-80, Section 2.4.4.1, last paragraph: Please explain the conclusions that short-term impacts would be less than a factor of 2 for thermal-load scenarios and that the impacts would be highest for the low thermal load and lowest for the high thermal load scenario.

19 Page 2-81, Section 2.4.4.2, final bullet: This item should refer to the Section 6 discussion of assessing impacts on cultural resources of Native Americans.

Section 3. Affected Environment

General Ground Water Issues

20 Section 3 of the draft EIS provides information about the hydrogeologic conditions in the vicinity of Yucca Mountain. The certainty of this information varies considerably, and it is difficult for the reader to understand how uncertainties will be resolved and how the data still being gathered will affect the design of the repository and the projections for ground water contamination. EPA suggests that the final EIS summarize ongoing studies and their expected impact on design and on ground water quality projections.

21 Most of the ground water studies described in Section 3 were done on a regional scale and may not provide accurate site-specific data for the saturated zone beneath the proposed repository. Section 3 provides general statements about ground water data, but fails to inform the reader about aquifer-specific data, such as the length of time data have been collected on the carbonate aquifer and the number of wells sampled over various periods of time. This information is particularly important for modeling the transport of radionuclides in the saturated zone.

22... EPA has previously discussed with DOE and NRC the calculations used to determine whether applicable radiation standards are met; determining whether the standard is met requires DOE to project the concentration of radionuclides in the water at the point of compliance. In order to do this, DOE must identify various scenarios for the type and quantity of waste released over time, transport path, and the concentrations predicted for the various options for representative volumes

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22 cont. of ground water (e.g. 10 to 1,285 acre feet), at the various distances selected as possible points of compliance. We did not find this data identifiable in the draft EIS and suggest that the final EIS provide a discussion of this information and a summary table.

Section 3.1.4, Specific Hydrology Comments

23 Page 3-41, Section 3.1.4.2.2: This section describes the Topopah Spring tuff unit, in which the repository will be built, as fractured, very permeable, and extensively interconnected; and, perched water forms at its contact with the underlying Calico Hills non-welded unit. Page 3-48 states that water chemistry analysis has found that "perched water reached its current depth with little interaction with rock. This, in turn, provides strong evidence that flow through faults and fractures is the primary source of perched water." The final EIS should address this concern: if seismic activity occurred at these fault zones, water could move faster (or slower) through the faults and fractures, possibly increasing the mounding of perched water. This is different than the "upwelling" referred to on page 3-49.

24 Page 3-46: The final EIS should provide an up-to-date analysis of the chlorine-36 transport data.

25 Page 3-49: Lower carbonate aquifer. Since data are limited, the EIS should not conclude that the lower carbonate aquifer has an upward gradient. Page 3-51 states that there is only one transmissivity value based on tests from a single well. Also, on page 3-52, it seems preliminary to count this aquifer as a possible source of inflow to the volcanic aquifers. The final EIS should acknowledge the limited confidence that can be placed on the gradient interpretation with the data currently available.

26 Page 3-52: The final EIS should provide data from the ongoing investigations on the cause of the potentiometric difference north and south of the site, and it should describe what these data suggest about the potential for water from the north to flood the repository.

27 Page 3-57: In the discussion about water levels in the 7 wells, the significance of their proximity or distance to Fortymile Wash is unclear.

28 Page 3-63, Section 3.1.5.1.4: This section states that "Fortymile Wash and some of its tributaries might be classified as Waters of the U.S..." It is likely that Fortymile Wash is a Water of the U.S., as well as the Amargosa River and its tributaries: Yucca Wash, Drill Hole Wash, Midway Valley Wash, Busted Butte Wash, Solitario Canyon Wash, and Crater Flat. Also, tributaries to the washes stated above may meet the Waters of the U.S. criteria, per U.S. Army Corps of Engineers assessment.

Other Section 3 issues

29 Page 3-31: We are confused about the discussion of the Amargosa River system and the statement that there is a ground water discharge near Beatty, NV. The final EIS should clarify the direction of the ground water flow which, according to Figure 3-13 (page 3-38), does not appear to be in the direction of Beatty.

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30 Page 3-79, Section 3.1.8: The assessments of impacts to the local populations appropriately focus on the current demographics of the area. However, there should also be some consideration given to short-term (~20 years) projections of population and land use, particularly in the area directly south of the repository where potential receptors are located. While the National Academy of Science (NAS) recommends against long term (thousands of years) projections of population characteristics, the changing demographics in the greater region around the site argue for considering a reasonable compromise between long term projections and a static situation, such as extending local planning projections for a decade or two. For example, projections of growth at the 20-kilometer location indicate modest population increases.

31 Page 3-82, second full paragraph: The DOE's value of 0.0005 latent cancer fatalities per person-rem is lower than the Federal Guidance level of 0.000575 latent cancer fatalities per person-rem (Table 7.3, page 174, Federal Guidance Report 13, "Cancer Risk Coefficients for Environmental Exposure to Radionuclides," EPA 402-R-99-001, September 1999). Since DOE was one of the funding, reviewing, and approving agencies for this study, EPA recommends that the Federal guidance level be used.

32 Page 3-142, Section 3.3.3: This section states that, "DOE calculated the river flow past each population center...and used this number in the calculation to determine dose to the population." The final EIS should provide the dose calculation used.

33 Page 3-142, Sections 3.3.2 and 3.3.3: The draft EIS briefly discusses ground and surface water impacts, but we were unable to find an assessment of ground water contamination from a surface spill. The transportation impacts analysis should consider ground water recharge zones and the proximity of transportation corridors to ground water supplies and community water systems.

Section 4. Environmental Consequences of Repository Construction, Operation and Monitoring, and Closure

Section 4.1.3, Impacts to Hydrology

34 Page 4-24: Activity in drainages and washes may require a Section 404 permit if it takes place in Waters of the U.S.

35 Page 4-25, Section 4.1.3.3: The assessment of impacts to ground water should reference the discussion on radionuclide transport in ground water in Section 5.2. Readers may be confused by the page 4-25 discussion which focuses on the impact from spills and the potential for a contaminant to infiltrate and percolate through the unsaturated zone, rather than on the full range of ground water contamination.

Other Ground Water Concerns

36... Container breaches. The final EIS should discuss the expected scenarios for container breaches and the associated impacts on ground water, taking into account ground water contamination

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36 cont. levels at various distances and under various repository loadings. These analyses should cross-reference discussions on impacts to ground water.

37 Impact on ground water from transport spills. The draft EIS assesses the impact of spills on surface water, but the final EIS should also assess ground water contamination from a surface spill. The transportation impacts analysis should consider ground water recharge zones and the proximity of transportation corridors to ground water supplies and community water systems.

Section 4.1.4, Biological Resources

38 Page 4-30, Section 4.1.4.2: This section states that "routine releases of radioactive materials from the repository would consist of radioactive noble gases, principally isotopes of krypton and radon." Does DOE have any examples of where these types of releases are currently occurring? If so, are they monitored and have there been any impacts to biologic communities?

39 Page 4-33: DOE should plan to construct the evaporation ponds with side slopes or a ramp to facilitate wildlife use.

40 Page 4-35: While the impact on the threatened desert tortoise population is unclear (see comment on section 6.3.1.1), EPA questions whether the impact should be rated as low or very low. Some federally listed desert tortoises were killed during site characterization and more will likely be killed during construction, operation and monitoring, and closure. With increased human activity and traffic over the life of the project, the increases may be significant. EPA notes that DOE is obtaining a Biological Opinion from the Fish and Wildlife Service (page 4-33); any mitigation/conditions for protecting the tortoise should be listed in the final EIS.

Section 5. Environmental Consequences of Long-Term Repository Performance

41... Long-Term Repository Performance: General Comment

EPA disagrees with certain aspects of the performance assessment described in Section 5 and in Appendix I. The Total System Performance Assessment, presented in the Viability Assessment for Yucca Mountain and captured in the draft EIS analysis, relies in some instances on extreme performance cases which either omit or overestimate certain effects.

EPA recommends using an approach -- reasonable expectation -- which focuses on a more realistic depiction of repository performance and which recognizes the inherent uncertainties in projecting repository performance over the long term. This more realistic approach projects the expected behavior of the waste containment and isolation system, but avoids extreme assumptions and use of unrealistic performance scenarios.

We believe the final EIS would be strengthened by identifying the more conservative assumptions used in the assessment. Identifying these would give the reader a better sense of the variability inherent in the estimates of repository performance and provide the public with a more balanced

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41 cont. performance projection.

Section 5.1, Inventory for Performance Assessment Calculations

42 Table S-1 on page 5-5 and the related discussion in sections 5.1 and 8.3.1.2.3 (Atmospheric Radioactive Material Impacts) fail to consider post-closure releases of radon from the spent nuclear fuel in the time period beyond 10,000 years. EPA's proposed standards for Yucca Mountain at 40 CFR Part 197 require an analysis of the dose to a reasonably maximally exposed individual for the period beyond 10,000 years through the time of peak dose (64 FR 46976, August 27, 1999). The National Academy of Sciences' Yucca Mountain panel in 1995 estimated that the Yucca Mountain site would be stable on the order of one million years. The final EIS must therefore discuss releases of radon-222 (^{222}Rn), which will result from the decay of the considerable inventory of uranium in the spent nuclear fuel.

43 Section 5.5 (Atmospheric Radiologic Consequences) concludes that carbon-14 (^{14}C) is the only radionuclide that has the potential for transport through the atmosphere. Likewise, section 8.3.1.2 addresses only ^{14}C releases with respect to cumulative impacts. The draft EIS does examine the exposures to workers and offsite individuals from radon as a result of various operations. However, as noted by Sullivan and Pescatore ("Release of Radon Contaminants from Yucca Mountain: The Role of Buoyancy Driven Flow," T.M. Sullivan and C. Pescatore, Brookhaven National Laboratory, BNL-52468, February 1994):

> "Barometric and wind pumping at Yucca Mountain may cause long-term ^{222}Rn removal from the oxidized spent fuel waste. The problem of enhanced ^{222}Rn release to the accessible environment would pose itself later in time (after 20,000 years and peaking in roughly 200,000 years) and would last for as long as unsaturated conditions would prevail at Yucca Mountain."

44 EPA's analysis of spent fuel radionuclide inventories in support of the promulgation of 40 CFR Part 191 (see EPA 520/4-79-007A, 1977) indicates a ^{222}Rn content of about 1 curie per metric ton of heavy metal, at 100,000 years following discharge from a light water reactor. This would imply a repository inventory for ^{222}Rn of about 63,000 curies at about 100,000 years for the currently authorized Yucca Mountain repository. Because of its energetic radiations and numerous daughter radionuclides, ^{222}Rn presents a significantly larger risk per unit of radioactivity than ^{14}C.

45 Section 5.5 also indicates (introductory paragraph) that impacts for the global population were estimated. What value was used for the projected collective dose received by the global population?

46 Page 5-5: The final EIS should explain the statement on page 5-5 that chemically toxic materials were eliminated from consideration because "their total quantity would be very low and dilution in the repository environment would reduce their concentration to below toxic levels before they entered the saturated ground water system."

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47 Page 5-13: Section 5.2.3.4 discusses the different paths radionuclides can take, but should discuss pathways through the alluvial, volcanic and carbonate aquifirs.

Section 5.3. Locations for Impact Estimates

48 Page 5-23: This section states "Because of this pressure difference, water from the volcanic aquifer does not flow into the carbonate aquifer; rather the reverse occurs." This statement relies on just one data point in the carbonate aquifer. In Chapter 3, this uncertainty was noted. One data point does not provide certainty, and the EIS should not assume that the entire carbonate aquifer has an upward gradient, given the amount of fracturing and faulting involved. Nor should the EIS state that no contamination will occur at Ash Meadows, since Chapter 3 noted that it was a discharge point.

49 Page 5-27, second paragraph and Page 5-31, bottom paragraph: Page 5-27 states that 22 acre-feet of water per year infiltrate through the repository, while page 5-31 cites 25 acre-feet. Which value is correct?

50 Page 5-43, Section 5.7.2, second paragraph: It would be helpful to have a graphic representation of the results of the volcanic activity analyses.

51 Page 5-44, first paragraph: It is difficult to understand the first part of this paragraph. Please explain the sentence: "Because of its low velocity, the magma would not be removed from the waste package."

Section 6. Environmental Impacts of Transportation

National Transportation Impacts.

52 Section 6.2.1: This section describes how the EIS bounds the impacts to human health, safety and the environment from transportation by examining the two extremes of transportation possibilities - -mostly rail and mostly legal-weight truck. Based on DOE's analysis, EPA agrees with DOE's overall assessment that radiological impacts to the public from transportation of wastes to Yucca Mountain will be small.

53 In addition, the EIS recognizes the need to prepare for and respond to accidents. Page 6-30 highlights section 180(c) of the Nuclear Waste Policy Act under which DOE will provide technical assistance and funding to state, local and tribal public safety programs on transportation emergencies. This page also describes how transportation contractors must prepare an emergency response plan and take other steps to deal with the consequences of accidents.

54... EPA appreciates that the actual shipments of waste will not likely occur for another 10 years and understands DOE's reluctance to provide additional information on likely routes for waste transport. However, EPA sees no reason why DOE cannot commit to making this information available as the time for shipments approaches. DOE is doing this now for shipments to the

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54 cont. Waste Isolation Pilot Plant in New Mexico. Once DOE has greater certainty about the routes along which waste shipments will travel, the Department will also be able to update and expand upon, if needed, the environmental justice or other impact analyses which are route-specific.

55 In addition, EPA suggests that the final EIS provide a section which lays out the responsibilities of various federal, state, local and tribal agencies in regulating, approving and monitoring shipments of nuclear waste. This information should provide additional assurance to the public that a national network of controls is in place designed to ensure public safety.

56 Page 6-17, Section 6.1.3, second paragraph: The next-to-last sentence says that "an air quality conformity analysis [for carbon monoxide] may be required." If a conformity determination is needed, it should be made before completion of the NEPA process. EPA suggests such information be included in the final EIS.

57 Page 6-20, third bullet: The term "dose risk" is not a standard term. What does it mean when used in the phrase, "to estimate radiological dose risk to populations"?

58 Page 6-38, Section 6.3.1.1: DOE recognizes that desert tortoises will be killed as a result of transportation operations. The Department reaches the conclusion that "any desert tortoises killed by trucks transporting spent nuclear fuel or high-level radioactive waste probably would be only a small fraction of all desert tortoises killed on highways." This may be true, but what is the anticipated impact of this operation relative to the desert tortoise population on the Nevada Test Site (NTS)? The higher concentration of shipments on the NTS could result in a proportionately higher impact than in the general environment. However, it may be possible that the impact on the tortoise population might be less than in the general environment since the NTS has a protection program in place. See also EPA comment on page 4-35.

Section 7. Environmental Impacts of the No-Action Alternative

59 Page 7-38, end of the first partial paragraph: EPA appreciates that for comparison purposes and to avoid the appearance of bias toward the preferred alternative, "DOE did not want to overestimate the impacts from Scenario 2." However, the document should provide an estimate or a range of impacts for the reader.

Section 8. Cumulative Impacts

60 Page 8-27, Section 8.2.2.1.2: This section refers to 40 CFR Part 61 which contains EPA's Clean Air Act regulations for radiological effluents from a variety of facilities; however, this rule is not applicable to Yucca Mountain. More appropriate references are 40 CFR Part 191, Subpart A (Environmental Standards for Management and Storage, 50 FR 38066, September 19, 1985) or proposed 40 CFR Part 197, Subpart A (Environmental Standards for Storage), both of which address airborne radiological releases and external exposures from Yucca Mountain during the operational period.

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61 Page 8-47, Table 8-22: This table and several other tables in section 8 list "MEI dose (millirem)", but do not indicate whether this dose occurs in one year or over the total closure period. Some of the doses are rather large compared to established radioactive waste standards, such as the 58 millirem listed for the MEI dose for Inventory Module 1 or 2. To properly judge the impact, the exposure period must be specified.

62 Page 8-66, Table 8-46: For Inventory Module 1, the gross alpha concentration is missing.

63 Page 8-74, Item 7 and the final paragraph: This item, *Greater Confinement Disposal* (GCD), does not indicate that there is transuranic radioactive (TRU) waste at the Nevada Test Site, in addition to low-level radioactive waste (LLW). The final EIS should so note since the TRU waste has a greater potential for adding to the impact from Yucca Mountain than does the LLW.

64 Page 8-75, Table 8-55: Out of the 9.3 million curies in GCD, tritium and americium are the only ones identified as "major or known isotopes." DOE needs to state the basis for determining a "major isotope."

65 Page 8-77, Section 8.3.2.1.2: This section assumes that the risk of radiological impacts is directly scalable to the radiological content of the waste disposed in the GCD facility. However, the GCD wastes are disposed in a different manner than that contemplated for the Yucca Mountain repository (namely, closer to ground surface) and the source term likely contains a different mixture of radionuclides than anticipated for disposal at Yucca Mountain; therefore, relating the risk of GCD disposal to its inventory is overly simplistic and should be re-examined.

Section 9. Management Actions to Mitigate Potential Adverse Environmental Impacts

Design Changes

66... Pages 9-12 through 9-16, Section 9.2.8: The design alternatives discussed in this section are outdated with the Department's adoption of the EDA II design. The final EIS should discuss the new design of the engineered barrier components (e.g., elements designed to minimize water contact with the packages, increase containment lifetime, or retard radionuclide movement out of the repository); it should also discuss the operational choices (e.g., a prolonged retrievability period) that dictated the design changes and reduced uncertainties in assessing performance of the system.

The final EIS should also contrast significant changes in the engineered barrier performance assessment with the assessments for the older design. For example, the DOE/VA design assumed a juvenile package failure at 1,000 years, a major contributor to the dose calculations within 10,000 years. Estimating the rate and timing of juvenile failures is very difficult since the failure mechanisms are hard to predict. With the addition of drip shields, this uncertainty is effectively eliminated since releases would only occur if a drip shield is breached over a package with a juvenile failure - a very low- probability event.

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66 cont. The performance assessment of the new design should describe the string of processes and events needed to release radionuclides, e.g., the probability that a drip shield would prematurely fail, the probability that a waste package would prematurely fail, the probability that these failures would be co-located, and the probability that a ground water seep would be located over the failed drip shield. A presentation in the final EIS that describes the new design in terms of its expected performance can help justify the design change, support the bounding argument for the older design, and increase confidence in the repository assessments.

Tribal Coordination/Consultation (various sections and appendices)

67 Page 9-22: This section refers to the Yucca Mountain Project Native American Interaction Program for promoting a government-to-government relationship with area tribes. Pages C-7 to C-9 also discuss DOE's interaction with tribal governments on the proposed project. Representatives from the "Consolidated Group of Tribes and Organizations" have met with DOE on a range of issues. The Consolidated Group includes Southern Paiute Tribes, Western Shoshone Tribes, Owens Valley Paiute and Shoshone Tribes, and the Las Vegas Indian Center. EPA commends DOE's efforts to work with Tribes within Nevada and neighboring states, but we also encourage DOE to inform and reach out to other Tribes which may be affected by waste shipments.

Shipments of spent nuclear fuel and/or DOE high-level radioactive waste may cross Tribal lands in various parts of the country, and if DOE has not already done so, we encourage the Department to commence a government-to-government consultation process with such Federally-recognized Tribes. In order to facilitate public and agency disclosure under NEPA, the final EIS should identify those Tribes which may be affected by the transportation of waste across or close to Tribal land. This discussion should also include any potential effects on tribal resources.

68 The draft EIS (Figures 2-26 and 2-27) depicts U.S. interstate and rail routes which are potential corridors for waste proposed for disposal at Yucca Mountain. We recommend that the final EIS provide a modified overlay of these two figures to depict Tribal lands through which waste bound for disposal at Yucca Mountain may pass via road or rail. The Bureau of Indian Affairs (BIA) has a 1993 map for Indian Land Areas in the lower 48 states. This map depicts the location of tribal lands in relationship to the Federal highway network, and may be useful for this effort.

69 Pages 3-68 through 3-70: This section discusses tribal historical and cultural beliefs but provides little information on how Native Americans think the proposed project may affect their cultural resources. Page 3-70 refers to a resource document prepared by the American Indian Writers Subgroup, but does not summarize the concerns therein or explain how to obtain a copy of the document.

70 We also note that while Appendix D indicates that the draft EIS was distributed to the Department of the Interior's Office of Environmental Policy and Compliance (Dr. Willie R. Taylor), it does not appear that a copy was sent directly to the Bureau of Indian Affairs (BIA). We recommend that the Department of Energy provide the BIA with a copy of the final EIS.

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Section 11. Statutory and Other Applicable Requirements

Pages 11-6 and 11-7, Nevada Water Quality Standards

71 It is unclear whether the draft EIS has fully analyzed potential water quality impacts of the proposed project (especially the environmental consequences of long-term repository performance) per Nevada water quality standards. The final EIS should provide this analysis and discuss any needed mitigation.

72 Section 1.3.2 states that waterborne chemically toxic materials that could threaten human health are present in materials disposed of in the repository, the most abundant being uranium, as well as nickel, chromium and molybdenum (used in the waste package). EPA agrees with the analysis on page 5-6 of the conditions under which waste materials disposed at Yucca Mountain could threaten human health: (1) the waste packages and their contents are exposed to water, (2) radionuclides and/or chemically toxic materials in the package materials or wastes become dissolved or mobilized in the water, and (3) radionuclides or chemically toxic materials are transported in water to an aquifer; further, such water must be withdrawn via a well or surface discharge point and used by humans as drinking water or in the human food chain.

73... Pages 11-6 and 11-7 of the Draft EIS highlight several important requirements of the Federal Clean Water Act (CWA) and Nevada's Revised Statutes which were passed to carry out the legislative requirements of the CWA and EPA's regulatory programs. The draft EIS recognizes the CWA Section 313 requirement that any project or activity by a Federal department or agency resulting (or which may result) in the discharge or runoff of pollutants comply with Federal, State, local and interstate water pollution requirements. Water Quality Standards are designed to protect both existing and designated beneficial uses of a water body. The Water Quality Standards adopted by the State of Nevada and approved by U.S. EPA require that:

- The water must be suitable for the watering of livestock without treatment.
- The water must be suitable as habitat for fish and other aquatic life existing in a body of water.
- The water must be suitable for propagation of wildlife and water fowl without treatment.
- The unique ecological or aesthetic value of the water must be maintained.
- The water must support natural enhancement or improvement of water quality in any water which is downstream (see NAC 445A.122, approved by U.S. EPA under authority of the Federal CWA).

Page 3-31 describes the hydrologic system of the Yucca Mountain region, noting that the Amargosa River system drains Yucca Mountain and surrounding areas. The Yucca Mountain regional groundwater system includes "discharge points," defined as "locations where groundwater reaches the surface." The draft EIS notes that groundwater discharges to channels near Beatty, Nevada, south of Tecopa, California, and in southern Death Valley, California. (See also EPA's question about the Beatty discharge point under Section 3 issues.)

Because the Amargosa River flows into Death Valley, California (p. 3-31), it is presumably an interstate water regulated by Nevada water quality standards (NAC 445A.213(5)). These standards provide that "Radioactive materials attributable to municipal, industrial or other controllable sources must be at the minimum concentrations which are physically and

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73 cont. economically feasible to achieve. In no case must materials exceed 1/10 of the 168-hour values for other radioactive substances specified in National Bureau of Standards Handbook 69." Regarding radioactive materials, the Water Quality Standards stipulate that "...concentrations in water must not result in accumulation of radioactivity in plants or animals that result in a hazard to humans or harm to aquatic life" (NAC 445A.121(6)).

California Water Quality Standards

74 Page 3-31 states that ground water reaches the surface at three locations, including one in southern Death Valley, California. However, the draft EIS does not discuss whether any potential migration and subsequent discharge of contaminated groundwater from the project (from repository construction, operation, closure, or long-term performance) would be consistent with the State of California's Water Quality Standards for this geographic area. The final EIS should provide this analysis and discuss any needed mitigation.

75 The relevant California standards are in the Water Quality Control Plan for the Lahontan Region, developed by the California Regional Water Quality Control Board, approved by EPA and last updated in October 1994. This Plan identifies water quality objectives for surface waters; specifically, page 3-6 of the Plan specifies "Radionuclides shall not be present in concentrations which are deleterious to human, plant, animal, or aquatic life nor which result in the accumulation of radionuclides in the food web to an extent which presents a hazard to human, plant, animal, or aquatic life." The Plan further provides that waters with a designated beneficial use of "MUN" (waters used for community, military or individual water supply systems) shall not contain a concentration of radionuclides in excess of the limits specified in Table 4, Section 64443 (radioactivity) of Title 22 of the California Code of Regulations.

The Plan identifies larger hydrologic units (such as the Amargosa Hydrologic Unit and the Death Valley Hydrologic Area), and geographically smaller subunits (such as the Tecopa Wetlands, and minor surface waters and minor wetlands in the Death Valley Hydrologic Area), and lists specific beneficial uses that must be protected. Beneficial uses for the Tecopa Wetlands include municipal and domestic water supply, freshwater habitat, wildlife habitat, preservation of biological habitats of special significance, habitat for rare, threatened and endangered species, migration of aquatic organisms, and water quality enhancement. Many of these same beneficial uses also apply to the minor surface waters and minor wetlands of Death Valley, which in addition are designated beneficial uses of ground water and fresh water replenishment.

Compliance with Resource Conservation and Recovery Act (RCRA), Page 11-11

76... Mixed radioactive and hazardous waste is subject to RCRA requirements, including applicable permitting requirements. The draft EIS states that DOE will not accept hazardous waste for disposal at Yucca Mountain and that any hazardous or mixed waste which is generated will not be treated or disposed on-site, nor will it be stored for more than 90 days. Accordingly, "DOE does not expect to need a Resource Conservation and Recovery Act permit for its activities at the proposed repository."

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76 cont. Page 1-7 of the draft EIS indicates that high-level wastes from DOE sites would be immobilized through vitrification before shipment to Yucca Mountain. Vitrification meets the RCRA Land Disposal Restriction treatment standard for these wastes. Various DOE documents indicate that organic solvents and hazardous chemicals, in addition to toxic heavy metals, are typically contained in high-level radioactive waste. The final EIS should explain why the high-level waste to be disposed of at Yucca Mountain will not be RCRA regulated.

77 The final EIS should also clarify the applicability of RCRA to the data presented in Table I-10 (page I-15) in Volume II, "Inventory [kilograms] of Chemical Materials Placed in the Repository under the Proposed Action." Under "high-level radioactive waste" the table lists 19,000 kilograms of barium, 43,000 kilograms of cadmium, 2,000 kilograms of lead, 200 kilograms of mercury, and 300 kilograms of selenium. Pursuant to RCRA, EPA has established regulatory levels (mg/L) for barium (100.0 mg/L), cadmium (1.0 mg/L), lead (5.0 mg/L), mercury (0.2 mg/L), and selenium (1.0 mg/L). (See 40 CFR 261.24, Toxicity Characteristics.)

PCBs and Asbestos

78 Section 11 of the draft EIS does not discuss the applicability of the Toxic Substances Control Act or of regulations governing asbestos disposal. The final EIS should clarify whether any waste proposed for disposal at Yucca Mountain is or may be contaminated with PCBs (polychlorinated biphenyls), or whether any radioactive asbestos waste is destined for disposal at Yucca Mountain, and, if so, the regulatory implications of such.

Other Section 11 Comments

79 Page 11-18, Table 11-2: The table should include DOE Order 435.1 which applies to this action unless the requirements of the order "overlap or duplicate" requirements of the Nuclear Regulatory Commission (NRC).

80 Page 11-20, Table 11-3: The table should list 40 CFR Part 191, Subpart A (Environmental Standards for Management and Storage) which applies to certain areas in the vicinity of the proposed Yucca Mountain repository.

Section 14. Glossary

81... Page 14-8, definition of "controlled area": This definition is inconsistent with how this term is used in 40 CFR Part 191 (see 50 FR 38085, September 19, 1985) and in proposed 40 CFR Part 197 (64 FR 47013, August 27, 1999). The definitions in EPA's rules limit the controlled area size to no more than five kilometers from the repository footprint. (There is an additional option in proposed 40 CFR Part 197 with which this definition is also inconsistent.) EPA recognizes that the size of the controlled area for physical control purposes during the active institutional control period might be different than the area used for performance assessment purposes, but if so, the distinction should be clarified on page 14-8 and in the appropriate places in the final EIS.

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82 Page 14-19, definition of "inadvertent intrusion": The word "unintended" needs to be inserted before "disturbance," i.e., "The *unintended* disturbance of a disposal facility ...." As currently written, the definition would include purposeful intrusions.

83 Page 14-19, definition of "institutional control": This definition should distinguish between "active institutional control," which requires the presence of humans to take actions to safeguard and repair the repository, and "passive institutional control," which also includes controls such as permanent markers and land records to warn future generations of dangers from the disposal site.

84 Page 14-22, definition of "maximally exposed individual": The last sentence of this definition equates the maximally exposed individual (MEI) with the "reasonably maximally exposed individual (RMEI)," a term used in the recently proposed 40 CFR Part 197 (see 64 FR 46988 and 47014/47015, August 27, 1999). These two terms are very different. The dose incurred by the MEI is calculated by using the most conservative values (i.e., producing the highest dose) for all parameters needed to calculate the dose to an individual. The dose incurred by the RMEI, on the other hand, assumes that one or a few parameters are at their maximum or most conservative values while the others are at their average values.

Page 14-29, definition of "reasonably maximally exposed individual": See previous comment.

Appendix I. Environmental Consequences of Long-Term Repository Performance

85 Page I-49, fourth full paragraph: The document described in the final sentence should be referred to as Federal Guidance Report No. 11.

86 Page I-111, last reference. Please replace the authors' names in the first column with the EPA report number.

Appendix J. Transportation

87 Page J-8, second full paragraph: This paragraph discussed the methodology used to estimate the radiation impact resulting from accidents. The spectrum of possible accident severity was divided into categories. Then "each category of severity received a conditional probability of occurrence." A release fraction was assigned to each category. Please provide a brief discussion of how values were assigned and a table listing the values.

Appendix K. Long-Term Radiological Impact Analysis for the No-Action Alternative

88 Page K-7, Figure K-3: This map shows failure times for above-ground concrete storage modules. The no-action impact analysis looked at a 100-year time frame, yet Figure K-3 indicates that in some areas of the country, failure could be expected in less than 75 years and, in other areas, between 75-100 years. The final EIS should evaluate the premature failure potential for those areas of the country where such could be expected in less than 100 years.

89... Page K-26, Section K.2.5.2: This section discusses the potential for criticality involving stored

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89 cont. spent fuel. EPA agrees with the assessment that criticality for high-level nuclear waste is impossible, but believes the EIS should expand the assessment of low probability for criticality in stored spent fuel canisters. The text states that only water entry, and its retention in the canisters, would allow a criticality to develop; and, the discussion further acknowledges the possibility of degradation of the concrete storage facilities, allowing water entry. Yet, the text does not assess the probability that dripping water could corrode the fuel containers, allowing water to enter and remain there for some time, potentially causing a criticality.

The text discusses three types of criticality events, but does not connect them to more explicit container corrosion failures scenarios or evaluate the relative probabilities of each failure type. DOE should more explicitly analyze corrosion failures (penetration of the container and corrosion of the internal components) from water entering the storage container and the potential for various criticalities. It is plausible that dripping water could corrode a storage container, allowing water to collect and fill the container (a scenario similar to NRC's performance scenario for a breached waste package in the repository).

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RESPONSES TO U.S. ENVIRONMENTAL PROTECTION AGENCY COMMENTS ON THE DRAFT EIS (Comment Document 1632)

1. Thank you for your comment.

2. DOE assumes that the fundamental data referred to in the comment mean such things as aquifer properties, retardation coefficients, hydraulic heads, etc. Such data are detailed in the documents referenced in Appendix I of the EIS.

   Appendix I contains detailed information in support of Chapter 5 of the EIS. As stated in the introduction to Appendix I, the long-term performance analysis was conducted using a TSPA model and supporting data derived from the TSPA models and data that support other Yucca Mountain Project documents. As also stated, the purpose of Appendix I is not to republish the large body of available information but to reference the sources of the information and describe any special additional modeling and data used for the EIS. Some common background material was duplicated as an overview to enhance understanding of the incremental material. Thus, much of the detailed data on saturated zone modeling in this EIS is from the *Total System Performance Assessment for the Site Recommendation* (DIRS 153246-CRWMS M&O 2000) and the *FY 01 Supplemental Science and Performance Analyses* (DIRS 155950-BSC 2001), as referenced in the Final EIS.

   The Final EIS discusses the new Environmental Protection Agency standard (40 CFR Part 197).

3. DOE agrees with the Environmental Protection Agency's assertions regarding future actions should the United States decide to not proceed with construction and operation of a repository at Yucca Mountain. As stated in Section 2.2 of the EIS, if Yucca Mountain was determined to be unsuitable or was not approved by the President or Congress, DOE would prepare a report to Congress. This report, required by the NWPA, would contain DOE recommendations for further action to ensure the safe, permanent disposal of spent-nuclear fuel and high-level radioactive waste, including the need for new legislative authority. Other than this action, the future course that Congress, DOE, and the commercial nuclear utilities would take is uncertain. Several possibilities could be pursued, including centralized interim storage or the study of another location for a a deep geologic repository. However, it would be too speculative to say that any of these actions would be pursued.

4. As explained in the EIS, the purpose of the pretreatment process is to separate the high-activity fraction, which requires the permanent isolation afforded by a repository, from the low-activity fraction. This large volume of low-activity waste is subject to a "waste incidental to reprocessing determination," as provided for in DOE's Radioactive Waste Management Manual (DOE M435.1-1). A waste stream can be managed as low-level waste if the waste incidental to reprocessing determination shows that it meets the following criteria:

   - The key radionuclides are removed to the extent technically and economically practical (this is accomplished by pretreatment).

   - It is managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, Performance Objectives.

   - It is managed in accordance with the DOE M 435.1-1 low-level waste requirements and is incorporated into a solid physical form at a concentration less than the Class C limits set out in 10 CFR 61.55.

   The Waste Incidental to Reprocessing provision was included in the August 6, 1998, drafts of DOE Order 435.1 and DOE M 435.1-1 that were made available for public comment. DOE has since issued DOE Order 435.1 for implementation.

DOE has modified Section 1.2.3 of the EIS to reflect that low-level waste would be disposed of in accordance with applicable regulations.

5. As the Environmental Protection Agency notes, the Draft EIS evaluated the preliminary design concept described in the *Viability Assessment of a Repository at Yucca Mountain* (DIRS 101779-DOE 1998) for repository surface facilities, and disposal containers (waste packages). DOE noted in the Draft EIS (in Section 2.1.1.5, for example) that the analyzed designs were preliminary and were likely to evolve in various ways. Since it issued the Draft EIS, DOE has continued to evaluate design features and operating modes that would reduce uncertainties in or improve long-term repository performance, and improve operational safety and efficiency. The results of the design evolution process was the development of the Science and Engineering Report flexible design. This design focuses on controlling the temperature of the rock between the waste emplacement drifts (as opposed to areal mass loading), but the basic elements of the Proposed Action to construct, operate and monitor, and eventually close a geologic repository at Yucca Mountain are unchanged. DOE evaluated the flexible design in a Supplement to the Draft EIS, which was released for public review and comment in May 2001.

   Aspects of the design in the Supplement to the EIS (as well as this Final EIS) are likely to continue to evolve, particularly in relation to the means of controlling heat generated by spent nuclear fuel and high-level radioactive waste. Under Section 114(a) of the NWPA, DOE must provide a description of the proposed repository, including preliminary design specifications, as part of any Site Recommendation. If the Yucca Mountain site was approved, a more refined flexible design would be determined only at the time of License Application to the Nuclear Regulatory Commission. That design probably would continue to change as a result of the License Application process.

   In this Final EIS, DOE varied design parameters to create lower- and higher-temperature operating modes in such a way to provide the range of potential environmental impacts. DOE believes that the EIS adequately analyzes each design element investigated, the resulting short- and long- term environmental impacts, and mitigation measures. Further, the analyses incorporate conservative assumptions that tend to overestimate impacts, as identified in the EIS. For example, in Section G.1.1 of the EIS the total nonradiological air quality impacts were the sum of the calculated maximum concentrations regardless of wind direction. This conservatively maximized air quality impacts. This type of approach to estimate impacts conservatively was applied to all other resources, as appropriate.

   Because of the various implementing alternatives and scenarios analyzed as well as the conservative nature of the analyses, DOE believes that the analyses represent a realistic upper bound of environmental impact that could occur from the implementation of the Proposed Action.

6. The Draft EIS evaluates the preliminary design concept described in the *Viability Assessment of a Repository at Yucca Mountain* (DIRS 101779-DOE 1998) for repository surface and subsurface facilities as well as disposal containers (waste packages). It also evaluates the plans for the construction, operation and monitoring, and closure of the repository. DOE recognized before it published the Draft EIS that plans for a repository would continue to evolve during the development of any final repository design and as a result of any licensing review of the repository by the U.S. Nuclear Regulatory Commission. The design evolution is evaluated in the Supplement to the Draft EIS and integrated into the Final EIS. The Supplement to the Draft EIS incorporates new information, including an improved understanding of the interactions of potential repository features with the natural environment, the addition of design features for enhanced waste containment and isolation, and evolving regulatory requirements. The design will continue to evolve in response to additional site characterization information, technological developments, and interactions with oversight agencies.

   As described in the Supplement to the Draft EIS and incorporated into the Final EIS, the waste package has been redesigned to include a thick outer shell of corrosion-resistant high-nickel alloy (Alloy-22) and a thick inner shell of stainless steel for strength. This newer design resists corrosion far better than the design described in the Draft EIS, and has improved the predicted performance of the repository and reduced uncertainties associated with that performance. A description of the flexible design waste package can be found in Section 2.3.4.1 of the Supplement to the Draft EIS and Section 2.1.2.2.2 of the Final EIS.

The type and amount of neutron absorber necessary for a specific waste package design would be determined by DOE prior to receipt of a license from the Nuclear Regulatory Commission to receive and posses spent nuclear fuel and high-level radioactive waste. This would have to be done consistent with a criticality analysis methodology that has been accepted by the Commission. The specifics of that methodology are presented in Disposal Criticality Analysis Methodology Topical Report, which DOE submitted to the Commission in January 1999.

7. DOE has considered onsite and offsite locations for the Cask Maintenance Facility. A site for the landfill has not yet been identified. DOE would identify an appropriately sized landfill at the repository site for nonhazardous and nonradiological construction and sanitary solid waste, and for similar waste generated during operation, monitoring, and closure of the repository. Although the Cask Maintenance Facility may not be located at the Yucca Mountain site (therefore not depicted on current site drawings), the EIS analysis assumed the landfill and the Cask Maintenance Facility would be located at the repository. By doing so, the environmental impacts of these facilities were considered in the EIS. DOE believes that the amount of information in the EIS on these facilities is adequate to determine representative environmental impacts.

8. Figure 2-10 shows the location of the cooling tower at the North Portal Operations Area. DOE would use the cooling tower exclusively for air conditioning of surface facilities at the repository. The tower would not be a source of chemical contamination or radiological emissions. The Final EIS has been revised to state that the cooling tower is not a source of chemical or radiological emissions or contamination.

9. DOE would emplace waste packages in underground tunnels at the same time it was constructing additional tunnels. However, the two areas of operation would be isolated from one another. Section 4.1.3.2 of the EIS discusses potential impacts to surface water from repository construction, operations, maintenance, monitoring, and closure. As stated in that section, DOE would pump water from subsurface construction areas to a lined evaporation pond at the South Portal Operations Area. It would pump water from the emplacement areas, if any, to a lined evaporation pond at the North Portal Operations Area, but only after verifying that it was not contaminated.

   DOE would remove solid materials through mining operations, but only from the development area. Bulkheads would isolate this area from the emplacement side, and the ventilation system would ensure that air leaks would be from the development side to the emplacement side (because it would maintain a lower pressure on the emplacement side).

10. As described in the Supplement to the Draft EIS and incorporated into the Final EIS, the waste package has been redesigned to include a thick outer shell of a corrosion-resistant high-nickel alloy (Alloy-22) and a thick inner shell of stainless steel for strength. This newer design would resist corrosion far better than the design described in the Draft EIS, and would improve the predicted performance of the repository and reduced uncertainties associated with that performance. Section 2.1.2.2.4 of the EIS describes the waste package design.

11. DOE agrees that the limitation or prevention of intentional and unintentional activities around the closed repository could not be guaranteed.

12. DOE would design and implement a postclosure monitoring program in compliance with the Nuclear Regulatory Commission regulations (10 CFR Part 63). Before closure, DOE would submit an application for a license amendment to the Commission for review and approval. The application would include, among other items:

    1. An update of the assessment of the performance of the repository for the period after closure

    2. A description of the postclosure monitoring program

3. A detailed description of measures to regulate or prevent activities that could impair the long-term isolation of the waste, and to preserve relevant information for use by future generations

The application also would describe DOE's proposal for continued oversight to prevent any activity at the site that would pose an unreasonable risk of breaching the repository's engineered barriers, or increase the exposure of individual members of the public to radiation beyond limits allowed by the Nuclear Regulatory Commission. DOE has modified Chapter 9 of the EIS to include the types of monitoring and other institutional controls that would be contemplated. The Department would develop the details of this program during the consideration of the license amendment for closure. This would allow the Department to take advantage of new technological information, as appropriate.

13. DOE agrees that the limitation or prevention of intentional and unintentional activities around the closed repository could not be guaranteed.

14. DOE believes that the mostly rail scenario, in which more than 95 percent of spent nuclear fuel and high-level radioactive waste would be shipped by rail, and the rest by legal-weight truck, would most closely approximate the actual mix of truck and rail shipments. In reaching this conclusion, DOE considered the capabilities of the sites to handle larger (rail) casks, the distances to suitable railheads, and historic experience in actual shipments of nuclear fuel, waste or other large reactor-related components. DOE also considered relevant information published by sources such as the Nuclear Energy Institute and the State of Nevada. In addition, DOE has identified mostly rail as its preferred mode of transportation, both nationally and in Nevada. At this time, however, the Department has not identified a preference among the five candidate rail corridors in Nevada.

15. The EIS focuses on analyses of potential environmental impacts, including impacts to human health and safety. DOE provided the estimated cost information as a point of comparison between the Proposed Action and the No-Action Alternative. The cost estimates in the Draft EIS were in 1998 dollars with no escalation or discount rates. The reference cited in the comment (DIRS 104980-CRWMS M&O 1999) provides the basis for the Proposed Action cost estimate for the period from 2002 to 2116. As stated in that reference, most of the detailed information came from existing cost estimates for the 1999 to 2116 period in the *Viability Assessment of a Repository at Yucca Mountain* (DIRS 101779-DOE 1998) and from the *Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program* (DIRS 102031-DOE 1998), which both provide detailed year-by-year cost estimates. The EIS estimates include all costs from 2002 forward (when DOE anticipates a decision regarding development of a repository at Yucca Mountain). Costs for the Proposed Action and the No-Action Alternative would be the same up to that time. Costs for siting and characterization of the Yucca Mountain site were not included in the Draft EIS estimates. Section 2.1.5 of the Final EIS provides revised cost estimates for the repository flexible design.

The No-Action Alternative cost estimate in Section 2.2.3 of the EIS is a comparative cost estimate and only includes costs different from the costs of the Proposed Action. For example, the No-Action costs do not include storage costs until 2010 when a repository would first accept spent nuclear fuel and high-level radioactive waste because storage until that point would be required under both the Proposed Action and the No-Action Alternative. The No-Action cost estimate is based on, and consistent with, existing industry experience for dry onsite storage of spent nuclear fuel and high-level radioactive waste. Section 2.2.3 of the Final EIS provides revised cost estimates for the No-Action Alternative.

16. The full quote of the last sentence is:

"Because these projections are based essentially on best available scientific techniques, DOE focused the assessment of long-term impacts on human health, biological resources, surface-water and groundwater resources, and other resource areas for which the analysis determined the information was particularly important and could establish estimates of impacts." (Draft EIS, p. 2-74)

The intent of this statement is that DOE assessed all important impacts in the long-term period. No analyses were omitted because of inability to establish an estimate. Some resource areas (such as noise, utilities, and

services) were deemed to have no foreseeable impact and no detailed analysis was necessary. DOE realizes that even the full quote is confusing and has, therefore, revised the language in the Final EIS.

17. The value of 2.4 rem listed in the table in Section 2.4.4.1 of the EIS would be the dose to a hypothetical person assuming that exposure would be limited to 100 millirem per year. DOE has added a footnote to the table to include this information. Section 6.2.3.1 contains more information.

18. The statement is correct, and the information in Section 4.1 of the Draft EIS supports the conclusions. However, the paragraph in question was out of place in the Draft EIS. Potential impacts of the transportation of spent nuclear fuel would not be related to thermal load scenarios of the Draft EIS or to the flexible design analyzed in the Final EIS. The paragraph in question has been deleted.

19. The purpose of the bullet in Section 2.4.4.2 referred to in this comment is to identify salient conclusions that can be drawn from the information in the summary table in that section. For this reason, DOE has not included modifications or references to other sections in the Final EIS.

20. DOE believes that it has sufficient information and understanding of the hydrologic setting to adequately determine the potential environmental impacts from the Proposed Action. DOE and others have been evaluating and assessing the hydrologic setting and associated characteristics at the Yucca Mountain site and nearby region for many years. DOE's site characterization program has been redirected from time-to-time to reflect and accommodate reviews by independent parties, both internal and external to the Department. Nevertheless, it is clear that the regional and site-specific hydrologic setting is complex and uncertainties remain. Additional information would refine DOE's understanding of, for instance, the regional groundwater flow system, and would further reduce uncertainties associated with flow and transport in the alluvial, volcanic and carbonate aquifers.

    In recognition of these uncertainties, DOE has supported Nye County with its program (called the *Early Warning Drilling Program*) to characterize further the saturated zone along possible groundwater pathways from Yucca Mountain, as well as the relationships among the volcanic, alluvial, and carbonate aquifers. Information from the performance confirmation program (if Yucca Mountain is approved for a repository) could be used in conjunction with that of the Early Warning Drilling Program to refine the Department's understanding of the flow and transport mechanics of the saturated alluvium and valley-fill material south of the proposed repository site, and to update conceptual and numerical models used to estimate waste isolation performance of the repository. When DOE published the Draft EIS, only limited information from the Early Warning Drilling Program was available. Since then, however, this program has gathered additional information (see Section 3.1.4.2.1 of the EIS).

    In addition, DOE has installed a series of test wells along the groundwater flow path between the Yucca Mountain site and the Town of Amargosa Valley as part of an alluvial testing complex. The objective of this program is to better characterize the alluvial deposits beneath Fortymile Wash along the east side of Yucca Mountain. Single- and multi-well tracer tests have begun and the results thus far have strengthened the basis of the site-scale saturated flow and transport model. This program is described in Section 3.1.4.2.1 of the EIS.

    Although DOE has improved its understanding of the hydrologic system, uncertainties would remain given the time frame of concern (waste isolation for thousands of years). If the site was approved, DOE would institute a *performance confirmation and testing program*, elements of which would address the hydrologic system. The purpose of this program would be to evaluate the accuracy and adequacy of the information used to determine whether the repository would be expected to meet long-term performance objectives. The performance confirmation program, which would continue through closure of the repository (possibly as long as 300 years), would offer a means to further understanding of the hydrologic system and reduce uncertainties.

21. DOE has initiated a program to evaluate the hydrologic processes in the saturated zone, particularly the hydrogeologic relationship between the volcanic aquifer, alluvial aquifer, and carbonate aquifer. This is currently being addressed through a cooperative agreement between Nye County and DOE, referred to as the

Early Warning Drilling Program. Recent results from this program have been incorporated into this Section 3.1.4.2.1 of the EIS.

Section 3.1.4.2.2 of the EIS refers to large hydraulic gradient north of the site. Specific information related to the saturated zone and carbonate aquifer can be found in the cited references in Section 12 of the EIS. With regard to the saturated zone and the carbonate aquifer, one well (UE 25p #1) penetrated the carbonate aquifer at Yucca Mountain, another well (NC-EWDP-2DB), along the potential flow path in Fortymile Wash, has penetrated the carbonate aquifer and an upward hydraulic gradient was present. Well NC-EWDP-2DP, along with six additional planned wells, will help characterize the carbonate aquifer system near Yucca Mountain as part of the Nye County Early Warning Drilling Program. Four other wells at Yucca Mountain, as reported by Luckey et al (DIRS 100465-1996), are believed to indicate the potentiometric level in the carbonate aquifer. Elsewhere in the general area, particularly at the southern end of the Nevada Test Site and eastward from the springs in Ash Meadows, the hydraulic relationship between the lower carbonate aquifer and overlying units is well understood (DIRS 101167-Winograd and Thordarson 1975). The very presence of the springs in Ash Meadows demonstrates the fact of an upward hydraulic gradient in the lower carbonate aquifer. Because the lower carbonate aquifer is buried by some 6,000 feet of unconsolidated deposits in the Amargosa Desert west of the springs in Ash Meadows, no wells have been drilled into this aquifer. Claassen (DIRS 101125-1985) presents the hydraulic and hydrochemical evidence of subsurface discharge from the lower carbonate aquifer to the alluvial fill of the Amargosa Desert to the west of Rock Valley Wash. In addition, several investigations have concluded from hydrologic, chemical, and isotopic evidence that the lower carbonate aquifer is the source of the large springs in Furnace Creek Wash (Death Valley). Thus, the understanding of the flow system and hydraulic relationships of the lower carbonate aquifer are based not only on data from well UE 25p #1 at Yucca Mountain, but on a large body of regional hydrologic and chemical evidence collected over the past 40 years.

22. The Draft EIS reported groundwater concentrations and then compared the results to current Safe Drinking Water Act standards for four points of compliance: 5, 20, 30 and 80 kilometers (3, 12, 19, and 50 miles) from the repository. It reported the concentrations for both the mean and 95th percentile of a set of 100 stochastic realizations of the undisturbed case release scenario, which determines the type and quantity of waste released over time. Chapter 5, Appendix I, and the Viability Assessment (DIRS 101779-DOE 1998) discuss this scenario. The Draft EIS reported results for three thermal load scenarios for the peak occurring within 10,000 years after repository closure.

DOE did not use the concept of representative volume in the Draft EIS because of the nature of the groundwater model, which was the same as that used for the *Viability Assessment of a Repository at Yucca Mountain* (DIRS 101779-DOE 1998). This model simulates the saturated zone transport as a series of six parallel tubes that follow the general flow of groundwater south through Amargosa Valley to the surface discharge point at Franklin Lake Playa. These one-dimensional tubes have a concentration identified at the repository footprint (that is, all repository footprint water flows through the tubes), a dilution factor characterizes how much dispersion would occur, and a delay factor accounts for sorption. Thus, at the point of compliance the model assumes that groundwater is repository footprint water with a conservative dilution factor and delay time.

Since publication of the Draft EIS, the Environmental Protection Agency (EPA) and the Nuclear Regulatory Commission finalized their environmental protection and licensing criteria regulations (40 CFR Part 197 and 10 CFR Part 63, respectively), which provide an individual protection standard for the proposed Yucca Mountain Repository.

For the Final EIS, DOE used the definition of the Reasonably Maximally Exposed Individual (RMEI) from 40 CFR 197.21, which defines the individual as a hypothetical person who could meet the following criteria:

(a) Has a diet and living style representative of the people who are now residing in the Town of Amargosa Valley, Nevada. DOE must use the most accurate projections, which might be based upon surveys of the people residing in the Town of Amargosa Valley, Nevada, to determine their current diets and living styles and use the mean values in the assessments conducted for Sections 197.20 and 197.25.

(b) Drinks 2 liters (0.5 gallon) of water per day from wells drilled into the groundwater at the location where the RMEI lives.

The location of the RMEI described in 40 CFR Part 197 would be where the predominant groundwater flow path crosses the southern boundary of the Nevada Test Site which coincides with the southern boundary of the controlled area as defined in the regulation. This point is approximately 18 kilometers (11 miles) from the proposed repository. DOE has concluded that it is not necessary to analyze in the Final EIS a hypothetical individual at locations closer than approximately 18 kilometers to the repository because it is unreasonable to assume that anyone would reside in this area, because:

- An individual would need to install and operate a water well in volcanic rock at more than 360 meters (1,200 feet) deep to reach the water table at costs significantly above (and likely prohibitive) those that would be incurred several kilometers farther south of the repository where the water tables lies less than 60 meters (200 feet) beneath the surface through sand and gravel. and

- Locations closer than 18 kilometers (11 miles) are within the controlled area defined in the EPA standard for a Yucca Mountain repository and therefore not in the postclosure accessible environment defined by EPA.

The updated analysis in the Final EIS estimates potential groundwater impacts reported for the compliance point prescribed in 40 CFR Part 197 [approximately 18 kilometers (11 miles) from the proposed repository]. As part of a comprehensive presentation of impacts, this EIS is charged with providing groundwater impacts for two other important down gradient locations. These are 30 kilometers (19 miles), where most of the current population in the groundwater path is located, and 60 kilometers (37 miles) where the aquifer discharges to the surface (this location is also known as Franklin Lake Playa). This analysis indicates that for the first 10,000 years there would be only very limited releases, attributable to a small number of early waste package failures (zero to three, and possibly as many as five) due to waste package manufacturing defects, with very small radiological consequences (see Table 5-6). For the first 10,000 years after repository closure, the mean and 95th-percentile peak annual individual dose would be thousands of times less than the Environmental Protection Agency standard, which allows up to 15-millirem-per-year dose rates during the first 10,000 years. The peaks would be even smaller at greater distances.

DOE has revised the definitions of the maximally exposed individual and RMEI in the Final EIS. Chapters 4, 6, and 7 now use the term "maximally exposed individual," and Chapter 5 uses "individual." The individual is the "reasonably maximally exposed individual" defined in 40 CFR Part 197.

In addition, the Final EIS updated the groundwater protection analyses consistent with criteria provided at 40 CFR 197.30. The results of these analyses are provided in Tables 5-6 and 5-10 of Chapter 5 of the Final EIS and show that both the mean and 95th percentile estimated radionuclide concentrations during the 10,000 regulatory period are thousands of times less than the regulatory limits.

23. Section 3.1.4.2.2 of the EIS indicates that perched water is formed when water percolating down through the subsurface encounters a zone of lower permeability and, as a result, accumulates. Vertical movement of water probably stills occurs, but at a slower rate below the perched water than above. In the tilted strata at Yucca Mountain, the accumulation of perched water must be accompanied by a feature such as a fault to restrict the lateral movement of water. The surface of the perched water then remains at a fairly stable elevation once the inflow and outflow rates are balanced. At Yucca Mountain this is attributed to less infiltration (a drier climate than when most of the perched water accumulated) and/or the elevation of the perched water reaching a point where the lateral restriction changes and the water "spills" out, or it could just reflect a long-term, steady-state condition.

The commenter is correct that seismic activity could change the rate at which water moves in the unsaturated zone, but it would be much less likely to change the quantity of water moving through the unsaturated zone because quantity is related chiefly to climate. That is, the rate at which water would reach the perched zone might increase for a short period of time as water above it "drained" from the system as a result of increased permeability. But eventually the amount of water reaching the perched water would again be controlled by

the amount of water entering the system (that is, infiltration). For either the short-term increase in flux or the long-term climate-driven flux to cause significant "mounding" of the perched water, the seismic activity would have to result in a decreased permeability below the perched zone and/or an extension (lengthening) of the lateral restriction to flow. A scenario of increased perched water elevation is not addressed in the EIS because neither of these conditions would be expected to occur to any significant extent as a result of seismic activity. Compared to the overlying Topopah Spring welded unit, seismic activity might cause less fracturing in the Calico Hills nonwelded unit (the unit causing the perching condition), but it would not be expected to decrease the latter's permeability. The barrier to lateral flow at faults is believed to be the result of the juxtaposition of a more permeable layer against a less permeable layer caused by the fault displacement. Therefore, to lengthen the barrier, the offset would have to be lengthened. This is an obvious result of displacement, but the greatest displacement in the Yucca Mountain area [32-centimeter (13-inch); Section 3.1.3.3 of the EIS] would be exceeded less than once in 100,000 years. Correspondingly, fault displacement would not be expected to significantly increase the depth of perched water.

DOE has considered hundreds of "what if" scenarios involving features, events, and processes (FEPs) and how they might affect the long-term performance of the repository. Those scenarios not excluded because of low probability or low consequences or for other reasons were subjected to more detailed analysis and included in long-term performance modeling. This process is documented in DOE's FEP database and associated documentation. The FEP process does not specifically address "mounding" of the perched water, but it does cover what is believed to be a more realistic scenario; the relatively rapid draining of the perched water due to seismic activity. In this case, were such an event to take place after containers in the repository had begun to degrade, it could result in a fast pulse of contamination reaching the saturated zone. This scenario was excluded from analysis in the long-term performance modeling because it was reasoned that the volume of water associated with the perched system is not great enough to cause a significant "pulse" to the saturated zone.

24. As part of its site characterization activities, DOE has conducted a variety of investigations into the nature of water falling as precipitation on Yucca Mountain and passing through the unsaturated zone to the groundwater beneath. One such study has been to quantify the concentrations of certain radioisotopes in the Exploratory Studies Facility. Isotopes, such as chlorine-36 and tritium, which occur naturally and as a byproduct of atmospheric nuclear weapons testing, serve as indicators of the rate of flow through the unsaturated zone (see Section 3.1.4.2.2 of the EIS for details).

Results from preliminary studies have identified these isotopes in concentrations that tend to suggest that there are connected pathways through which surface precipitation has percolated to the repository horizon within the last 50 years. However, these isotopes have been found at locations that are generally associated with known, through-going faults and well-developed fracture systems close to the faults at the proposed repository horizon.

To ensure the correct interpretation of this chemical signal, DOE instituted additional studies to determine if independent laboratories and related isotopic studies can corroborate the detection of elevated concentrations of these radioisotopes. Results of the validation studies to this point have not allowed firm conclusions and, thus, the evaluations continue.

DOE believes that these findings do not indicate that the Yucca Mountain site should be declared unsuitable for development as a repository. Most of the water that infiltrates Yucca Mountain moves slowly through the matrix and fracture network of the rock, and isotopic data from water extracted from the rock matrix indicates that residence times might be as long as 10,000 years. Furthermore, after excavating more than 11 kilometers (8.4 miles) of tunnels at Yucca Mountain for the Exploratory Studies Facility, DOE determined that only one fracture was moist (there was no active flow of water). This observation has been confirmed in test alcoves that are not subject to the effects of drying from active ventilation.

Nevertheless, the total system performance assessment incorporates the more conservative water movement data as well as information from other water infiltration and associated hydrogeological studies. As a result of this evaluation, DOE would not expect the repository (combination of natural and engineered barriers) to exceed the prescribed radiation exposure limits during the first 10,000 years after closure.

25. DOE has started a program to evaluate the hydrologic processes in the saturated zone, particularly the hydrogeologic relationship between the volcanic aquifer, alluvial aquifer, and carbonate aquifer. This is currently being addressed through a cooperative agreement between Nye County and DOE, referred to as the Early Warning Drilling Program. Recent results from this program have been incorporated into this Section 3.1.4.2.1 of the EIS.

    With regard to the saturated zone and the carbonate aquifer, one well (UE 25p #1) penetrated the carbonate aquifer at Yucca Mountain, another well (NC-EWDP-2DB) along the potential flow path in Fortymile Wash penetrated the carbonate aquifer and an upward hydraulic gradient was present. Well NC-EWDP-2DP, along with six additional planned wells, will help characterize the carbonate aquifer system near Yucca Mountain as part of the Nye County Early Warning Drilling Program. Four other wells at Yucca Mountain, as reported by Luckey et al (DIRS 100465-1996), are believed to indicate the potentiometric level in the carbonate aquifer. Elsewhere in the general area, particularly at the southern end of the Nevada Test Site and eastward from the springs in Ash Meadows, the hydraulic relationship between the lower carbonate aquifer and overlying units is well understood (DIRS 101167-Winograd and Thordarson 1975). The very presence of the springs in Ash Meadows demonstrates the fact of an upward hydraulic gradient in the lower carbonate aquifer. Because the lower carbonate aquifer is buried by some 6,000 feet of unconsolidated deposits in the Amargosa Desert west of the springs in Ash Meadows, no wells have been drilled into this aquifer. Claassen (DIRS 101125-1985) presents the hydraulic and hydrochemical evidence of subsurface discharge from the lower carbonate aquifer to the alluvial fill of the Amargosa Desert to the west of Rock Valley Wash. In addition, several investigations have concluded from hydrologic, chemical, and isotopic evidence that the lower carbonate aquifer is the source of the large springs in Furnace Creek Wash (Death Valley). Thus, the understanding of the flow system and hydraulic relationships of the lower carbonate aquifer are based not only on data from well UE 25p #1 at Yucca Mountain, but on a large body of regional hydrologic and chemical evidence collected over the past 40 years.

26. Section 3.1.4.2.2 of the EIS refers to the large hydraulic gradient north of the Site. An expert elicitation panel addressed this feature and narrowed its likely cause to two theories: (1) flow through the upper volcanic confining unit or (2) semi-perched water. The consensus of the panel favored the perched-water theory. Whatever the cause, the experts were in agreement that the probability of any large transient change in the configuration of this gradient is extremely low (DIRS 100353-CRWMS M&O 1998). DOE has initiated a program to evaluate the hydrologic processes in the saturated zone, particularly the hydrogeologic relationship between the volcanic aquifer, alluvial aquifer, and carbonate aquifer. This is currently being addressed through a cooperative agreement between Nye County and DOE, referred to as the Early Warning Drilling Program. Recent results from this program have been incorporated into Section 3.1.4.2.1 of the Final EIS.

27. The reference from which DOE extracted this information does not correlate water-level fluctuations with proximity to Fortymile Wash. The Draft EIS mentioned this only because Fortymile Wash is an area of periodic recharge, which could have a local, temporary affect on the elevation of groundwater (see Section 3.1.4.2.2 of the EIS). The reference to the wells' proximity to Fortymile Wash has been removed.

28. The washes listed in the comment are tributaries to Fortymile Wash, and Fortymile Wash is a tributary to the Amargosa River. Because they are tributaries, the EIS text acknowledges that these washes might be classified as "waters of the United States." At present, there has been no formal designation of these drainage channels. Without such a designation, DOE believes that it is appropriate in the EIS to continue to indicate that these washes might be classified as waters of the United States. The Department will continue to coordinate with the Army Corps of Engineers regarding any possible future designation of these or other affected washes.

29. Section 3.1.4.1.1 of the EIS discusses surface water in the region of Yucca Mountain and indicates that groundwater discharges to the channel of the Amargosa River near the community of Beatty, Nevada. The purpose of this discussion is only to identify areas along the river channel where surface water exists on a regular basis. It is not to identify the source of the groundwater that supplies the flow; this information is included in the discussion of regional groundwater in Section 3.1.4.2.1 of the EIS (which includes

Figure 3-13). In the discussion of Basins in Section 3.1.4.2.1, the description of the Pahute Mesa-Oasis Valley groundwater basin indicates groundwater outflow is southward to the Amargosa Desert. The flow arrow shown in Figure 3-13 of the Draft EIS at the south end of the Pahute Mesa-Oasis Valley basin points southward toward Amargosa Desert and shows the groundwater pathway to be beneath the community of Beatty. Accordingly, groundwater discharged in the area of Beatty comes from the Pahute Mesa-Oasis Valley basin.

30. DOE revised its socioeconomic baseline projections and estimated impacts for the Final EIS incorporating population data available from the State of Nevada and local communities. The revisions include an estimated baseline projection to 2035 for the socioeconomic parameters considered in the EIS. In the Final EIS, the estimated population distribution within 80-kilometers (50-miles) of the repository is also based on projections to 2035 utilizing information available from State and local sources. The allocation of individuals to a particular sector within the 80-kilometer area was based upon surveys conducted in 2000. Figure 3-25 of the EIS provides the population distribution for 2035.

31. The Environmental Protection Agency recently published an age-specific risk factor of 5.75 chances in 10 million per millirem for fatal cancer (DIRS 153733-EPA 2000). However, DOE currently uses the value of 5.0 and 4.0 chances in 10 million per millirem for fatal cancer for members of the public and workers, respectively, as recommended by the International Commission on Radiological Protection (DIRS 101836-ICRP 1991). When recommending these risk factors, the International Commission on Radiological Protection also expressed the desirability, for purposes of radiation protection, to use the same nominal risk factors for both men and women and for a representative population with wide ranges in age. The Commission stated that although there are differences between the sexes and populations of different age-specific mortality rates, these differences are not so large as to necessitate the use of different nominal risk factors. However, the higher risk factor for members of the public compared to that recommended for workers accounts for the fact that children comprise a relatively large part of the population and are more sensitive to the effects of radiation (cancer induction) than adults. Although the embryo-fetus is more radiosensitive (with a radiation risk factor about two times that for the whole population) it is protected by the body of the mother and comprises a small part of the overall population. Pregnant women are not unduly radiosensitive, especially to low levels of radiation.

    Both the Agency and DOE recognize that there are large uncertainties associated with these risk factors, as expressed by the National Council on Radiation Protection and Measurements comment on the result of their uncertainty analysis in the risk coefficients that " … show a range (90 percent confidence intervals) of uncertainty values for the lifetime risk for both a population of all ages and an adult worker population from about a factor of 2.5 to 3 below and above the 50th percentile value" (DIRS 101884-NCRP 1997). The Department believes that the 15-percent difference in these risk factors is well within other uncertainties and would provide little additional information to the decisionmaking process that this document informs. For these reasons, DOE will continue to use risk factors recommended by the International Commission on Radiological Protection in their National Environmental Policy Act documents.

32. Appendix K of the EIS cites reference documents that include the details of the dose calculations. Information on these documents is available at DOE Reading Rooms and on the DOE Internet site (*http://www.ymp.gov*).

33. The EIS sections cited by this comment identify potentially affected waterways and groundwater characteristics pertaining to the 77 commercial and DOE generator sites. Sections 7.2.1.3 and 7.2.2.3 discuss the potential hydrologic impacts associated with the No-Action scenarios.

    With regard to transportation, Sections 3.2.2.1.3 and 3.2.2.2.3 of the EIS provides information on hydrology related to transportation corridors within Nevada. Table 3-37 and 3-39 present surface-water resources and groundwater basins, respectively, along the candidate rail corridors. Table 3-58 and 3-59 do the same for candidate heavy-haul truck routes. For Nevada transportation, potential impacts to hydrology from construction and operations are presented throughout Chapter 6. For example, see Section 6.3.2.2.1. The analyses are based on an identification of surface-water resources within the 400-meter (0.25-mile) corridor

for each alternative and outside the corridor, but within 1 kilometer (0.6 mile). Designated groundwater basins are identified.

DOE does not specifically analyze a transportation accident, such as a spill, involving contamination of surface water or groundwater because the casks are designed to be watertight and spent nuclear fuel and high-level radioactive waste are not easily dispersed in water. While small particles could be generated by the impact forces of an accident, and driven out of a shipping cask by a severe fire, the amount of contamination that could ultimately enter groundwater would be much lower than that which would initially enter surface waters. Factors such as soil sorption of radionuclides, rate of flow into recharge areas, dilution by rain water and surface water, dilution by the large volume of groundwater, and delay associated with infiltration would mitigate and greatly reduce any contamination that could occur. Therefore, water pathway contamination, including subsequent contamination of food and natural resources, would not be a significant contributor to the radiological risks of transporting spent nuclear fuel. DOE has, however, identified potential mitigation measures for surface water and groundwater from the construction and operation of transportation systems. See Sections 9.3.3.1 and 9.3.3.2 of the EIS.

34. DOE agrees with this comment and recognizes the potential need for Section 404 permitting. Section 11.2.2 of the EIS discusses this potentially applicable requirement. As indicated in Section 11.2.2, DOE may need to obtain a permit from the U.S. Army Corps of Engineers if the repository or the transportation facilities requires the discharge of dredge or fill materials into waters of the United States.

35. DOE concurs with this suggestion. Cross-references to Chapter 5 have been added to Section 4.1.3.3 to avoid confusion between short-term preclosure effects and long-term performance after closure.

36. In the analysis of long-term performance, breaches of the containers were not treated as separate scenarios but rather the result of modeling a number of features, processes, and events that then lead to various types of container breaches. As such then, there are no expected scenarios for container breaches. The impacts to groundwater result directly from the overall scenarios considered: nominal or "undisturbed" scenario, volcanic events, and human intrusion. These are clearly differentiated in the Draft EIS and the Final EIS with regard to groundwater impacts. Container breach is merely a process that is component to these broader scenarios. The Final EIS points out that general corrosion is a primary process for failure driving the dose results for the whole post-10,000-year period. Section I.5.1 of the Final EIS discusses waste package failures versus time and discusses the modes of failure and the relationship to the annual dose history.

37. DOE does not specifically analyze a transportation accident, such as a spill, involving contamination of surface water or groundwater because the casks are designed to be water tight and spent-nuclear fuel and high-level radioactive waste are not easily dispersed in water. While small particles could be generated by the impact forces of an accident, and driven out of a shipping cask by a severe fire, the amount of contamination that might ultimately enter groundwater would be much lower than that which would initially enter surface waters. Factors such as soil sorption of radionuclides, rate of flow into recharge areas, dilution by rain water and surface water, dilution by the large volume of ground water, and delay associated with infiltration would mitigate and greatly reduce any contamination that might occur. Although DOE's analyses in Chapter 6 take into account the proximity of surface waters and ground water basins (see Section 6.3.2.2.1 of the EIS as an example), water pathway contamination, including subsequent contamination of food and natural resources, would not be a significant contributor to the radiological risks of transporting spent-nuclear fuel. Analyses performed in previous EISs (see Section 1.5.3 and Table 1-1) have consistently shown that the airborne pathway has the greatest potential for exposing large numbers of people to radioactive material in the event of transportation accident resulting in the release of radioactive materials. DOE has, however, identified potential mitigation measures for surface water and groundwater from the construction and operation of transportation systems. The reader is referred to Sections 9.3.3.1 and 9.3.3.2.

While DOE believes the information presented in these sections of the EIS are sufficient to assess the relative merits of the alternatives, the Department acknowledges additional environmental reviews would be required to assess the potential impacts of such things as specific alignments through a transportation corridor.

38. Section G.2.3.2 of the EIS discusses releases of noble gases from spent nuclear fuel in repository surface facilities in more detail. Releases of noble gas radionuclides could occur at any commercial nuclear reactor sites that handle spent nuclear fuel. Such releases are documented in annual and semiannual environmental reports and published in a Nuclear Regulatory Commission summary, *Radioactive Materials Released from Nuclear Power Plants* (DIRS 155108-Tichler, Doty, and Lucadamo 1995).

    Krypton and other noble gases do not accumulate in environmental or biological media and, therefore, present little hazard to humans or the environment. Radon is somewhat different because of its decay products, but so little radon is released from spent nuclear fuel that it is almost immediately indistinguishable from naturally occurring radon in the environment. As stated in Section 4.1.4.2 of the EIS, estimated doses to plants and animals would be small and impacts from those doses would be unlikely to affect the population of any species because the doses would be much lower than 100-millirad-per-day. The International Atomic Energy Agency has stated that there is no convincing evidence that chronic exposures of 100 milliard per day will harm plant or animal populations. Neither of these noble gases is typically monitored in biologic communities because the potential for impact is so small.

39. DOE would consider providing escape ramps from trenches, including ponds and basins, as a mitigation measure (see Section 9.2.3.2 of the EIS).

40. The loss of a small number of tortoises along roads and at the repository site would not affect the long-term survival of the local or regional population of desert tortoises. Tortoises are widespread throughout the region and large tracts of undisturbed tortoise habitat surround Yucca Mountain. Research at Yucca Mountain during site characterization confirms that activities similar to those proposed would have little effect on adjacent populations (DIRS 104294-CRWMS M&O 1999). Only five Desert Tortoise deaths have been attributed to site characterization activities. The rate of tortoise mortality would remain comparable to that observed during site characterization because the amount of traffic would be similar. Under the legal-weight truck scenario, the repository would receive about 40 shipments a day of supplies, materials, and equipment (Section J.3.6.1 of the EIS), and up to six shipments of spent nuclear fuel or high-level radioactive waste (Section J.1.2.1 of the EIS). During site characterization, the daily average number of vehicles passing traffic counters in 1993 and 1994 was between 40 and 55 (DIRS 104294-CRWMS M&O 1999). DOE and the U.S. Fish and Wildlife Service have completed consultation on the potential effects of repository construction, operation, and monitoring and closure on threatened and endangered species. In its Biological Opinion, the Fish and Wildlife Service concluded that these actions would not jeopardize the continued existence of the Mojave population of the desert tortoise. That Opinion includes an unlimited take provision of tortoises along roads at Yucca Mountain, in part because deaths due to vehicles are anticipated to be infrequent. (See Appendix O of the EIS for the Biological Opinion.) Section 4.1.4 of the Final EIS has been modified to better explain the conclusion that the Proposed Action would not affect the tortoise population.

41. In general, the uncertainty approach used in the EIS uses realistic ranges of values for inputs and, where possible, acknowledges the uncertainty. In some instances, conservative assumptions are necessary to avoid the possibility of understating the potential impacts of the proposed Yucca Mountain Repository.

    An interesting outcome of a full uncertainty analysis of a system such as the proposed repository is that the use of "expected values" (for example, averages) for all parameters does not actually predict the expected outcome very well. Because of the skewed aspect of many input parameters to the models (a reflection of the real nature of the underlying data), the results predicted using only mean values actually produce a low-probability occurrence, usually in the 90th percentile or above of the outcomes predicted in a full stochastic assessment. Thus, it is more reasonable to perform a full stochastic assessment and report the expected outcome in terms of the statistics computed from the results. DOE did this in the EIS by reporting the mean outcome and the tail probability (95th percentile). However, the EIS has been revised to more clearly and more fully discuss both the modeling uncertainties and the degree of conservatism in the modeling.

42. Chapter 5 and Section 8.3.1 of the EIS now include analyses of atmospheric releases of radon-222 to the time of peak dose.

43. Chapter 5 and Section 8.3.1 of the EIS now include analyses of atmospheric releases of radon-222 to the time of peak dose.

44. Chapter 5 and Section 8.3.1 of the EIS now include analyses of atmospheric releases of radon-222 to the time of peak dose.

45. The referenced statement in Section 5.5 of the Draft EIS is an error. There was no global population calculation performed for the Draft EIS. The statement has been removed.

46. The overview of the screening process in the Draft EIS referred to a process detailed in Appendix I. DOE believes that Appendix I provided sufficient detail for a full understanding of what was done. In the updated analysis presented in the Final EIS, a different screening process was used due to design changes. This new screening process is detailed in Appendix I and cross-referenced in Chapter 5 of the Final EIS. The discussion in Final EIS Appendix I was designed to provide as clear and comprehensive explanation as possible.

47. The intent of Section 5.2.3.4 of the Draft EIS (Sections I.2.2 and I.2.8 of the Final EIS) is to describe the process models and radionuclide movement tendencies. Section 3.1.4.2.1 provides aquifer and pathway information.

48. DOE recognizes that additional data would further define the flow system and reduce uncertainties about the interactions among the alluvial, volcanic, and carbonate aquifers in the saturated zone. DOE has initiated a program to evaluate the hydrologic processes in the saturated zone, particularly the hydrologic relationships between the volcanic aquifer, alluvial aquifer, and carbonate aquifer. This is currently being addressed through a cooperative agreement between Nye County and DOE, referred to as the Early Warning Drilling Program. Recent results from this program have been incorporated into Section 3.1.4.2.1 of the Final EIS.

    It is correct that only one well penetrates the lower carbonate aquifer at Yucca Mountain. Four other wells at Yucca Mountain, as reported by Luckey et al (DIRS 100465-1996), are believed to indicate the potentiometric level in the carbonate aquifer. Additional wells are being drilled to characterize the carbonate aquifer system near Yucca Mountain as part of the Early Warning Drilling Program. One of the wells drilled under this program, which is about 19 kilometers (12 miles) south of the repository site, also penetrated the carbonate aquifer and shows an upward gradient at that location.

    With regard to the comment on Ash Meadows, groundwater that infiltrates through Yucca Mountain does not discharge at the Devils Hole Protective Withdrawal or in Ash Meadows. The elevation of the water table in the Devils Hole/Ash Meadows area is about 64 meters (210 feet) higher than the water table in the Amargosa Desert to the west and south. This east-to-west decline in the elevation of the water table indicates that groundwater from the carbonate rocks beneath the Devils Hole Hills flows westward across Ash Meadows toward Amargosa Desert--not the other way around. Therefore, contaminants from Yucca Mountain could not discharge at springs in Devils Hole and Ash Meadows nor contaminate the aquifer.

49. This comment identifies the infiltration rates for the high and intermediate thermal loads. The amount of infiltration, or flux, that would go through the proposed repository would vary based on the thermal loads being considered. Sections 5.4.1, 5.4.2, and 5.4.3 of the Draft EIS address the high, intermediate, and low thermal load scenarios, respectively. For each scenario, the footprint of the repository (that is, the size of the repository perpendicular to downward moving infiltration) expands to a larger size to support the lower waste loading. With the high thermal load scenario, the waste would be tightly packed and an estimated 27,000 cubic meters (22 acre-feet) of water would infiltrate through the repository. An estimated 31,000 cubic meters (25 acre-feet) of water would go through the repository under the intermediate thermal load scenario. With a low thermal load repository, the waste would be spread out and an estimated 57,000 cubic meters (46 acre-feet) of water would infiltrate through the repository. The same concept is applicable to the higher-and lower-temperature operating modes, which influence the size of the underground emplacement and, therefore, the estimated quantity of water that would infiltrate.

50. Section 5.7.2 of the Final EIS presents dose history curves for the volcanic scenarios showing the mean and 95th-percentile curves along with lines for the nominal case for comparison to results for various volcanic disturbance scenarios and the undisturbed waterborne release results.

51. This is a valid point. The sentence in question is confusing and has been deleted from the EIS.

52. Thank you for your comment.

53. DOE thanks the Environmental Protection Agency for its input. Information presented in Section M.5.1 of the EIS provides additional information related to emergency response planning and Section M.6 provides additional information on financial assistance programs.

54. If the Yucca Mountain site was approved for development of a repository, shipping routes would be identified at least 4 years before shipments began and Section 180(c) assistance would be made available approximately 4 years prior to shipments through a jurisdiction (see Section M.6 of the EIS). In accordance with 10 CFR 73.37(a)(7), actual route selection and submission to the Nuclear Regulatory Commission would occur 1 or more years before a route's use for shipment (see Section M.3.2.1.2 for more information). At this time, many years before shipments could begin, it is impossible to predict with a reasonable degree of accuracy which highway route or rail lines DOE would use. In the interim, states and tribes may designate alternative preferred highway routes, and highways and rail lines might be constructed or modified. Therefore, for purposes of analysis in this EIS, DOE identified representative highway routes in accordance with U.S. Department of Transportation regulations, which require the use of preferred routes (Interstate System highway, beltway or bypass, and state or tribal designated alternate route) that reduce time in transit (see Figure 6-11). DOE identified rail lines based on current rail practices, as there are no comparable Federal regulations applicable to the selection of rail lines for shipment of radioactive materials (see Figure 6-12).

    In response to public comments, DOE has included, state maps of representative highway routes and rail lines it used for analysis in Appendix J of the EIS (see Section J.4). Section J.4 includes potential health and safety impact estimates associated with shipments for each state through which shipments could pass.

55. Because of the public's interest in transportation, DOE has added to this EIS Appendix M and maps and tables that show the analyzed routes and estimated health and safety impacts for each state through which the shipments would pass. Appendix M provides general background information about transportation-related topics, such as transportation regulations (Section M.2), transportation operations (Section M.3), cask testing (Section M.4), and emergency response (Section M.5).

    DOE has issued a draft Request for Proposals requiring the Regional Servicing Contractor to prepare a transportation plan that describes the Contractor's operational strategy and delineates the steps it would implement to ensure compliance with all regulatory and other DOE requirements. This includes identification of proposed routes and associated routing considerations, coordination and communication with all participating organizations and agencies, including other Regional Servicing Contractor(s), DOE, state, Native American tribal, and local governments, and interactions with appropriate Federal and state organizations. The route and mode determinations would be interactive. If, during the course of the mode or route determinations, one of the previously determined factors changed, the site-specific mode and route analysis would be reevaluated to ensure consistency.

56. The Conformity Review discussions have been updated in all sections. Conformity Review results are summarized in Section 6.3.1.1 of the EIS for the mostly legal-weight truck scenario, in Section 6.3.2.1 for the mostly rail scenario, and in Section 6.3.3.1 for the heavy-haul truck scenario. The Conformity Review was focused on with levels of carbon monoxide and particulate matter (PM_{10}), for which the Las Vegas air basin has been classified as being in "serious nonattainment." Since the Draft EIS was published, the mostly rail scenario has been selected by DOE as the preferred transportation option. The Conformity Review found that more detailed analyses (that is, a Conformity Determination) would be required for the construction phase of a branch rail line in the Valley Modified Corridor, if that rail corridor was selected. The other corridors would not present a conflict with the General Conformity requirements for carbon monoxide and PM_{10}.

Emissions for constructing a branch rail line in the Valley Modified Corridor are estimated in the Conformity Review to be up to 145 metric tons (160 tons) per year (160 percent of the General Conformity threshold level) for carbon monoxide, and up to 120 metric tons (130 tons) per year (190 percent of the General Conformity threshold level) for PM_{10}.

The carbon monoxide emissions within the nonattainment area would result from fuel use by the construction vehicles and vehicle emissions from commuter and supply traffic to the Yucca Mountain site. The PM_{10} releases would include the emissions from disturbing the ground and from fuel combustion of the construction equipment. Dust abatement measures (for example, water applications) would reduce fugitive dust PM_{10} emissions by 70 percent. The emissions estimates could be reduced further by lengthening the construction time or more detailed task planning to reduce the production of emissions.

Emissions from a branch rail line in the Valley Modified Corridor into the nonattainment area would occur during the much longer operations phase, as the locomotive passed through the nonattainment area on its way to the Yucca Mountain site. However, operations phase emissions would not exceed the General Conformity threshold levels. The estimated operations emissions for a branch rail line in the Valley Modified Corridor would be 81 percent of the carbon monoxide General Conformity threshold level and less than 3 percent of the PM_{10} General Conformity threshold levels.

In addition, the Conformity Review compared the Valley Modified Corridor carbon monoxide and PM_{10} release estimates to the Nevada carbon monoxide and PM_{10} State Implementation Plans (DIRS 156706-Clark County 2000; DIRS 155557-Clark County 2001). The construction phase Valley Modified carbon monoxide emissions estimates would be less than 0.2 percent of the total daily carbon monoxide inventory emitted into the nonattainment area. The construction phase Valley Modified PM_{10} emissions estimates would be less than 0.08 percent of the daily and annual PM_{10} inventory emitted into the Las Vegas Valley air basin.

57. DOE defined "dose risk" in a text box in Section 6.1.1 of the EIS as follows:

"Dose risk is the sum of the products of the probabilities (dimensionless) and the consequences (person-rem) of all potential transportation accidents."

58. DOE and the U.S. Fish and Wildlife Service (see Appendix O of the EIS) have concluded that the loss of a small number of tortoises along roads and at the repository site would not affect the long-term survival of the local or regional population of desert tortoises. Tortoises are widespread throughout the region and large tracts of undisturbed tortoise habitat surround Yucca Mountain. Research at Yucca Mountain during site characterization confirms that activities similar to those proposed would have little effect on adjacent populations. The rate of tortoise mortality would remain comparable to that observed during site characterization because the amount of traffic would be similar. Under the legal-weight truck scenario, the repository would receive about 40 shipments a day of supplies, materials, and equipment (Section J.3.6.1 of the EIS), and six shipments of spent nuclear fuel or high-level radioactive waste (Section J.1.2.1). During site characterization, the daily average number of vehicles passing traffic counters in 1993 and 1994 was between 40 and 55 (DIRS 104294-CRWMS M&O 1999). The U.S. Fish and Wildlife Service has authorized an unlimited take of tortoises along roads at Yucca Mountain during repository construction and monitoring and closure in part because deaths due to vehicles are anticipated to be very infrequent (see Appendix O). Section 4.1 has been modified to better explain the conclusion that the Proposed Action would not affect the tortoise population.

59. As is typical for deterministic analyses such as those performed to evaluate No-Action Scenarios 1 and 2, the EIS analysis used best estimate single-input values to produce a best estimate result. As is also typical with these analyses, a separate analysis (semi-quantitative) addressed the uncertainty associated with the input values and assumptions and provided an assessment of the effects these uncertainties could have on the model results (see Section K.4 of the EIS for details).

However, for Scenario 2 the analysis provided a range of best estimate impact values between regions for collective, as well as individual, impacts (see the tables in Section K.3.1 of the EIS). This was done to illustrate the importance of environmental transport human exposure (exposed population) parameters. Also

under this scenario, a range of accident impacts was provided for high and low populations. Under Scenario 1, impact ranges were not developed because all collective and individual impacts were extrapolated from information provided by the Nuclear Regulatory Commission's environmental assessment of the Calvert Cliffs Independent Spent Fuel Storage Installation (DIRS 101898-NRC 1991).

As stated in Section K.4 of the EIS, DOE attempted to quantify a range of uncertainties associated with mathematical models and input data, and estimated the potential effect these uncertainties could have on collective human health impacts. By summing the uncertainties discussed in Sections K.4.1, K.4.2, and K.4.3 of the EIS where appropriate, DOE estimated that total collective impacts over 10,000 years could have been underestimated by as much as 3 or 4 orders of magnitude. However, because there are large uncertainties in the models used for quantifying the relationship between low doses (that is, less than 10 rem) and the accompanying health impacts, especially under conditions in which the majority of the populations would be exposed at a very low dose rate, the actual collective impact could be zero.

On the other hand, impacts to individuals (human intruders) who could move to the storage sites and live close to the degraded facilities could be severe. During the early period (200 to 400 years after the assumed loss of institutional control), acute exposures to external radiation from the spent nuclear fuel and high-level radioactive waste material could result in prompt fatalities. In addition, after a few thousand years onsite shallow aquifers could become contaminated to such a degree that consumption of water from these aquifers could result in severe adverse health effects, including premature death. Uncertainties associated with these localized impacts relate primarily to the inability to predict accurately how many individuals could be affected at each of the 77 sites over the 10,000-year analysis period. In addition, the uncertainties associated with localized impacts would exist for potential consequences resulting from unusual events, both manmade and natural. Therefore, as discussed in Section K.4 of the EIS, uncertainties resulting from future changes in natural phenomena and human behavior that cannot be predicted, process model uncertainties, and dose-effect relationships, when taken together, could result in overestimating or underestimating the impacts by as much as several orders of magnitude relative to the values listed in Section K.3.

60. DOE referenced 40 CFR Part 61 primarily because it provided a direct comparison to an air quality emission standard. Since publication of the Draft EIS, the Environmental Protection Agency promulgated *Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada,* at 40 CFR Part 197, which included an annual dose limit to a member of the public of 15 millirem (40 CFR 197.4). In accordance with requirements of the Energy Policy Act, the Nuclear Regulatory Commission subsequently promulgated Yucca Mountain licensing criteria, which includes a Preclosure Public Health and Environmental Standard at 10 CFR 63.204 of 15 millirem per year to a member of the public. The appropriate sections of the EIS (including those mentioned in Chapter 8) have been updated to reflect a comparison to the recently promulgated standard of 15 millirem.

61. The maximally exposed individual dose values in Table 8-22 of the Draft EIS are the integrated doses over the period of closure; six years each for the high and intermediate thermal-load scenarios and 15 years for the low thermal-load scenario. In Table 8-28 of the Final EIS (the table that corresponds to Table 8-22 of the Draft EIS), the closure period for the Inventory Modules ranges from 12 to 23 years for the higher-temperature and lower-temperature repository operating modes.

62. The Department has revised the table to include the information on gross alpha concentration in Table 8-49 of the Final EIS.

63. As indicated in Section 8.3.2.1, information on Greater Confinement Disposal on the Nevada Test Site is from the *Final Environmental Statement on the Nevada Test Site and Off-Site Locations in the State of Nevada* (DIRS 101811-DOE 1996). DOE included the description as it appears in the Nevada Test Site Final EIS, but DOE did not base its analysis on this description. Rather, the Department relied on the analyses in the Nevada Test Site EIS for input to Chapter 8. The Department acknowledges, however, that transuranic radionuclides are a part of the category of Greater Confinement Disposal, with americium isotopes as one example. The discussion in Section 8.3.2.1 of the Final EIS includes the presence of transuranic radionuclides in this category.

64. As indicated in Section 8.3.2.1, information on Greater Confinement Disposal on the Nevada Test Site is from the *Final Environmental Impact Statement on the Nevada Test Site and Off-Site Locations in the State of Nevada* (DIRS 101811-DOE 1996). The designation of "major known isotopes or wastes" is intended only to give the reader a broad sense of what would be included in the appropriate waste category and does not affect the analysis in this EIS. The Department relied on the analyses in the Nevada Test Site EIS for input to Chapter 8. As a consequence, DOE did not repeat the detailed composition of the radioactivity at the Nevada Test Site in this chapter.

    A footnote to Table 8-53 in the Final EIS clarifies that the table is intended for information purposes only.

65. In response to this comment, DOE has reexamined the discussion of waste subject to Greater Confinement Disposal and has modified Section 8.3.2.1.2 of the EIS to indicate that there is no credible mechanism for the long-term release of materials from the Greater Confinement Disposal to the accessible environment.

    The material subject to Greater Confinement Disposal is placed in boreholes that are approximately 37 meters (120 feet) deep; the waste itself is no closer than approximately 21 meters (70 feet) to the surface. DOE has reviewed previous analyses at the Nevada Test Site and has concluded that there is no credible pathway for long-term release of materials by resuspension of nonvolatile radionuclides because the material is sufficiently far below the surface. In addition, evapotranspiration exceeds precipitation in this region and this, coupled with the fact that the boreholes are sufficiently above the water table, indicates that there is no credible scenario for the Greater Confinement Disposal material to enter the groundwater.

66. As the Environmental Protection Agency notes, the Draft EIS evaluated the preliminary design concept described in the *Viability Assessment of a Repository at Yucca Mountain* (DIRS-101779-DOE 1998) for repository surface facilities, and disposal containers (waste packages). It also evaluated the plans for the construction, operation and monitoring, and closure of the repository. DOE recognized before it published the Draft EIS that plans for a repository would continue to evolve during the development of any final repository design and as a result of any licensing review of the repository by the U.S. Nuclear Regulatory Commission. The design evolution is evaluated in the Supplement to the Draft EIS and integrated into the Final EIS. The Supplement to the Draft EIS incorporates new information, including an improved understanding of the interactions of potential repository features with the natural environment, the addition of design features for enhanced waste containment and isolation, and evolving regulatory requirements. The design will continue to evolve in response to additional site characterization information, technological developments, and interactions with oversight agencies. Section 2.3.4 of the Supplement describes the design modifications (engineered barrier designs) including the addition of drip shields and refined waste packages.

    With regard to the design process, DOE is moving forward with a final design but acknowledges, as noted above and as documented by the Supplement to the Draft EIS, the design could further evolve. The updated design information presented in the Supplement was carried forward to the Final EIS. However, DOE believes the design has progressed to a point that it provides a reasonable basis for estimating the range of potential short- and long- term impacts that would likely result from any final design.

67. As noted by the EPA, DOE has consulted, and will continue to consult, with tribal governments as sovereign entities that possess authority and responsibility for Native American territory. A major objective of these consultations is to ensure that the EIS addresses the full range of Native American cultural and technical concerns related to the Proposed Action. Moreover, in these consultations DOE makes every effort to avoid compromising the interests of individual tribes and, thus, to minimize conflicts between tribes and tribal groups or other local (nontribal) government entities.

    Native Americans have expressed general concern about the impacts of the candidate rail corridors, heavy-haul truck routes, and intermodal transfer station locations. Consistent with its trust responsibilities, DOE does not intend to take action, make decisions, or implement programs without consulting affected tribal governments. In all cases, project decisions will incorporate input from affected tribes.

    DOE prepared the EIS in accordance with Section 2 of the Nuclear Waste Policy Act of 1982, which defines affected Indian Tribes as "…any Indian Tribe—(A) within whose reservation boundaries a monitored

retrievable storage facility, test and evaluation facility, or a repository for high-level waste or spent nuclear fuel is proposed to be located; and (B) whose federally defined possessory or usage rights to other lands outside the reservations boundaries arising out of congressionally ratified treaties may be substantially and adversely affected by locating such a facility: Provided that the Secretary of Interior finds, upon the petition of the appropriate government officials of the Tribe that such effects are both substantial and adverse to the tribe." For this EIS, "Native American" means "Indian" or "American Indian."

68. In response to public comments, DOE has revised Figures 2-25 and 2-26 of the EIS to show Federally recognized tribal lands located along highway and rail routes that could be used for national transportation.

69. DOE has maintained a Native American Interaction Program with 16 tribes and one organization since the mid-1980s. Tribal representatives are named by their respective tribes to sit on a DOE-funded, self-organized committee called the Consolidated Group of Tribes and Organizations, whose charter is to present their respective tribal concerns and perspectives to the Department. The Group meets twice per year and participates in field trips to Yucca Mountain to impart cultural resource protection information and to become more aware of the studies being conducted. While the Group does not support the potential use of Yucca Mountain as a repository, they have agreed to be involved in an honest and participatory process. DOE will continue to support the Group and Native American Interaction Program while carrying out the mission of characterizing the Yucca Mountain site. The DOE also supported an American Indian Writers Subgroup process in the preparation of a report that provides Native American perspectives on the repository to be used in writing the EIS. The Native American Interaction Program is described in Section 3.1.6.2.1 of the EIS. The Native American view of the affected environment is described in Section 3.1.6.2.2 of the EIS and the impacts from the Proposed Action are discussed in Chapter 4 of the EIS. Section 4.1.5.2 of the EIS addresses the Native American viewpoint with regard as to how the proposed project would affect cultural resources in the Yucca Mountain area. Section 4.1.13.4 of the EIS discusses the Native American perspective regarding the proposed repository and the surrounding region. These beliefs have been documented in *American Indian Perspectives on the Yucca Mountain Site Characterization Project and the Repository Environmental Impact Statement* (DIRS 102043-AIWS 1998), which has been sent to the commenter.

70. The Department of the Interior's expressed policy is that its bureaus receive National Environmental Policy Act documents through a coordinated distribution from its Office of Environmental Policy and Compliance. In addition, DOE will send a copy of the Final EIS directly to the Bureau of Indian Affairs as recommended.

71. Chapter 5 and Appendix I of the EIS describe environmental consequences (primarily potential groundwater impacts) from the long-term performance of the repository. Section 5.4 of the EIS contains information on the radiological impacts on human health, and Section 5.6 examines the consequences from chemically toxic materials during the first 10,000 years after closure. Environmental Protection Agency regulations (40 CFR Part 197) and Nuclear Regulatory Commission regulations (10 CFR Part 63) require that DOE demonstrate that releases from the repository would not exceed limits specified in those regulations over a 10,000-year period. DOE recognizes that some radionuclides and potentially toxic chemicals would, after long periods, eventually enter the environment outside the repository. Nevertheless, modeling of long-term repository performance indicates that the combination of natural and engineered barriers would keep doses resulting from such releases below the regulatory limits established by 40 CFR Part 197 and 10 CFR Part 63.

    Nevada water-quality regulations (Nevada Administrative Code 445A.119-225), discussed in Section 11.2.2 of the EIS, are not applicable to the long-term performance of the repository. These regulations specify water-quality standards that the Environmental Protection Agency and the State regulate by issuing permits for point-source discharges and runoff to maintain water quality. Section 4.1.3 of the EIS discusses the impacts to surface-water and groundwater hydrology during construction, operation and monitoring, and closure of the proposed repository. DOE does not anticipate any point-source discharges, but has concluded that repository operations would result in minor changes to runoff and infiltration. DOE would comply with all applicable permit conditions.

72. Thank you for your comment.

73. Chapter 5 and Appendix I of the EIS describe environmental consequences (primarily potential groundwater impacts) from the long-term performance of the repository. Section 5.4 of the EIS contains information on the radiological impacts on human health, and Section 5.6 examines the consequences from chemically toxic materials during the first 10,000 years after closure. Regulations established by the Environmental Protection Agency (40 CFR Part 197) and the Nuclear Regulatory Commission (10 CFR Part 63) require that DOE demonstrate that doses resulting from releases of radionuclides from the repository would not exceed limits specified in those regulations over a 10,000-year period. DOE recognizes that some radionuclides and potentially toxic chemicals would, after long periods, eventually enter the environment outside the repository. Nevertheless, modeling of long-term repository performance indicates that the combination of natural and engineered barriers would keep such releases below the regulatory limits established by 40 CFR Part 197 and 10 CFR Part 63.

    Nevada water quality regulations (Nevada Administrative Code 445A.119-225), discussed in Section 11.2.2 of the EIS, are not applicable to the long-term performance of the repository. These regulations specify water quality standards that the Environmental Protection Agency and the State regulates by issuing permits for point-source discharges and runoff to maintain water quality. Section 4.1.3 of the EIS discusses the impacts to surface water and groundwater hydrology during construction, operation and monitoring, and closure of the proposed repository. DOE does not anticipate any point-source discharges, but has concluded that repository operations would result in minor changes to runoff and infiltration. However, DOE does not anticipate any impacts from the repository on watering of livestock without treatment, habitat for fish and other aquatic life existing in a body of water, the suitability of the water for propagation of wildlife and waterfowl without treatment, or any unique ecological or aesthetic value of the water. DOE would comply with all applicable permit conditions.

74. Chapter 5 and Appendix I of the EIS describe environmental consequences from the long-term performance of the repository. Regulations established by both the Environmental Protection (40 CFR Part 197) and the Nuclear Regulatory Commission (10 CFR Part 63) require that DOE demonstrate that doses resulting from releases of radionuclides from the repository would not exceed limits specified in those regulations over a 10,000-year period. DOE recognizes that some radionuclides and potentially toxic chemicals would, after long periods, eventually enter the environment outside the repository. Nevertheless, modeling of long-term repository performance indicates that the combination of natural and engineered barriers would keep such releases well below the regulatory limits established by 40 CFR Part 197 and 10 CFR Part 63.

    The State of California Water Quality Standards are not directly applicable to discharges of groundwater to the surface. Water quality standards established by the Environmental Protection Agency and the states are regulated by the issuance of permits for point-source discharges and runoff to maintain water quality. Section 4.1.3 discusses impacts to surface-water and groundwater hydrology during construction, operation and monitoring, and closure of the proposed repository. DOE does not anticipate any point-source discharges, but has concluded that repository operations would result in minor changes to runoff and infiltration. DOE would comply with all applicable permit conditions.

75. The cited regulations are not directly applicable to the long-term performance of the proposed Yucca Mountain Repository. Regulations established by both the Environmental Protection Agency (40 CFR Part 197) and the Nuclear Regulatory Commission (10 CFR Part 63) require that DOE demonstrate that releases from the repository would not exceed limits specified in those regulations over a 10,000-year period. DOE recognizes that some radionuclides and potentially toxic chemicals would, after long periods, eventually enter the environment outside the repository. Nevertheless, modeling of long-term repository performance indicates that the combination of natural and engineered barriers would keep doses resulting from such releases well within the regulatory limits established by 40 CFR Part 197 and 10 CFR Part 63.

    The concentration of radionuclides at the chief discharge point (Franklin Lake Playa) after 10,000 years would not be deleterious to human heath (see Section 5.4) or to the health of plants or animals (see Section 5.9). Concentrations of radionuclides downgradient from Franklin Lake Playa (farther away from Yucca Mountain) after 10,000 years would be even lower.

76. Under *Waste Acceptance System Requirements Document* (DIRS 110306-DOE 1999), RCRA-regulated high-level radioactive waste would not be accepted for disposal at the Yucca Mountain repository. DOE is aware that the high-level radioactive waste at both the Idaho National Engineering and Environmental Laboratory and the Hanford Site contains listed hazardous wastes that would have to be "delisted" by the Environmental Protection Agency and the appropriate States. The Department would have to petition the Environmental Protection Agency to delist the waste. Petitions to the relevant states could also be required. DOE would work with the states and the Environmental Protection Agency to ensure they have the information they need to evaluate the delisting petitions.

    DOE high-level radioactive waste also exhibits certain characteristics of hazardous waste (specifically corrosivity and toxicity) prior to treatment. The treated waste would not exhibit any of the characteristics of a hazardous waste. Characteristic hazardous wastes do not require a petition and rulemaking by the Environmental Protection Agency to exit the hazardous waste system, although the Department would need to have supporting data and information to demonstrate that the characteristics have been removed from the treated waste form.

    DOE has revised the discussion in Chapter 11 of the Final EIS to clarify these questions.

77. The table in question appears in Section I.3.2 of the Final EIS. A footnote has been added to the table to show that the high-level waste form that would be disposed of in the proposed repository would not exhibit the Characteristic of Toxicity as measured by the Toxicity Characteristic Leaching Procedure. Section 11.2.4 discusses listed waste that would have to be delisted prior to emplacement in the repository. Waste shipped to the repository would not be regulated as hazardous waste under the Resource Conservation and Recovery Act.

78. Asbestos is not used in the manufacture of nuclear fuel, nor is it contained in high-level radioactive waste. Polychlorinated biphenyls (PCBs) are not used in the manufacture of nuclear fuel. While some high-level radioactive wastes are contaminated with PCBs, detectable levels of PCBs are unlikely to remain in the vitrified high-level radioactive waste forms. Therefore, the Toxic Substances Control Act, its implementing regulations, and regulations governing disposal of asbestos (or PCBs) are not applicable to the proposed repository.

79. DOE approved Order 435.1 after it issued the Draft EIS. As a result, it has included DOE Order 435.1 in the Final EIS table (Section 11.3), and has deleted the reference to DOE Order 5820.2A.

80. DOE has revised Table 11-1 of the EIS to include a discussion of the Yucca Mountain-specific radiation standards at 40 CFR Part 197 that would govern surface and subsurface operational activities at the repository. These new standards implement the general requirements of 40 CFR Part 191 for the proposed Yucca Mountain Repository.

81. This comment is correct. DOE has modified the definition of "controlled area" in the Glossary (Chapter 14) to be consistent with 40 CFR Part 197.

82. DOE agrees with this recommendation and has included this change in the EIS Glossary.

83. In EIS Glossary, DOE has modified the definition of institutional control to include the distinction between active and passive control.

84. DOE has revised these definitions in the Final EIS. Chapters 4, 6, and 7 now use the term "maximally exposed individual," and Chapter 5 uses "receptor." The receptor is equivalent to both the "reasonably maximally exposed individual" defined in the Environmental Protection Agency's regulations at 40 CFR Part 197. This change reflects the regulatory definitions and requirements for long-term performance recently promulgated by both agencies.

85. The text and reference cited in this comment do not appear in the Final EIS.

86. The reference format that DOE used in the EIS is consistent with document traceability requirements the Department established for the Yucca Mountain Project. The Environmental Protection Agency report number is part of the reference text.

87. Section J.1.4.2.1 of the EIS contains a discussion of accident severity categories, conditional probabilities, and release fractions. Figure J-9 shows the values for pressurized-water and boiling-water reactor spent nuclear fuel, respectively.

88. Both No-Action scenarios assume that the onsite storage facilities would remain under effective institutional control for the first 100 years. This means that they would be monitored and maintained with repairs being made as necessary to ensure the integrity of the dry storage canisters. DOE recognizes that the weather-protection structures (metal buildings for DOE below-grade storage vaults and reinforced concrete storage modules for commercial spent nuclear fuel), as currently constructed, would not likely remain intact for the 100-year institutional control period without major repairs. Therefore, the Department assumed that a major repair effort would occur 50 years into the 100-year period (see the figure in the introduction to Chapter 7 of the EIS). For purposes of analysis, DOE assumed this major repair effort to require 50 percent of the manpower and materials required to completely replace the facilities. Collective occupational radiation doses were estimated to be 72 and 118 person-rem for the Proposed Action and Module 1 scenarios, respectively (see DIRS 104596-Orthen 1999). Although not reported separately, these impacts have been included in the short-term (first 100 years) impacts for both scenarios, as discussed in Sections 7.2.1 and 7.3.2 of the EIS.

    Although the analysis assumed that under institutional control the storage facilities would be maintained and repaired as necessary, Sections K.4.1.1 and K.4.3.1 of the EIS discuss the uncertainties associated with maintenance of institutional control and uncertainties associated with environmental degradation and corrosion rates along with their potential impacts on the reported results. As stated in Section K.4.1.1, premature failure of effective institutional controls could result in an earlier release of radioactive materials to the accessible environment. However, this scenario would probably increase overall impacts by no more than a factor of 2.

89. DOE agrees that there is some limited potential for a criticality event to occur in degraded spent nuclear fuel canisters. However, DOE believes the discussion in Section K.2.5.2 of the EIS includes the appropriate level of analysis and qualitative description of probability. There are many uncertainties and speculative processes involved in the hypothetical scenario that assumes no effective institutional control after approximately 100 years, as well as the sequence of events that could occur within that scenario. DOE does not believe it is possible to establish defensible probabilities for this No-Action accident scenario or the components of the scenario described in this comment that could lead to potential criticality during extended periods of dry storage with no institutional control (Scenario 2 of the No-Action analysis). Other factors that the analysis would have to quantify to estimate those probabilities would be different climatic conditions around the country, the different types of commercially available dry storage configurations, the range of burnup in the spent nuclear fuel, and the initial enrichment of the fuel.

    Rather than specific probability analyses of the impacts associated with this No-Action scenario, the EIS provides qualitative descriptions of the relative likelihood of criticality events. First, the EIS states that criticality could be possible (in degraded storage canisters) if other conditions were met simultaneously. Those other conditions are a configuration that would allow water to enter but not drain out of the storage canister and fuel containing sufficient fissionable atoms to allow criticality. The second condition would depend on initial enrichment and burnup of the fuel. The EIS also states that a small amount of the spent nuclear fuel would be likely to have the appropriate enrichment burnup combinations, which could enable criticality to occur. Three types of criticality events were acknowledged as possible with only the most energetic type having potential to produce large impacts. That event is possible, but highly unlikely. It could happen only if sufficient amounts of fissionable material were brought together suddenly into a critical configuration. The more likely possibility would be for water to build up around degraded fuel elements. If fissions began to occur, the water would boil away and the criticality would stop. As noted in Section K.2.5.2 of the EIS, even the most energetic criticality would be unlikely to exceed the impacts associated with an aircraft crash onto a degraded dry storage module as evaluated in Section K.2.5.1. Therefore, DOE believes

that further quantification of the probability of such an event would not provide useful information or be defensible.

90. As noted in the comment, DOE indicated in the Draft EIS its intention to evaluate updated designs in the Final EIS. Design updates were first presented and evaluated in the Supplement to the Draft EIS issued in May, 2001 and then integrated into the Final EIS. The Supplement to the Draft EIS presents new information, including an improved understanding of the interactions of potential repository features with the natural environment, the addition of design features for enhanced waste containment and isolation, and evolving regulatory requirements. The design will continue to evolve in response to additional site characterization information, technological developments, and interactions with oversight agencies.

With regard to the design process, DOE is nearing a final design but acknowledges, as noted above and as documented by the Supplement to the Draft EIS, the design could further evolve. However, DOE believes the design has progressed to a point that it provides a reasonable basis for estimating the range of potential short- and long- term impacts that would likely result from any final design.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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JUN 28 2001

Dr. Jane R. Summerson, EIS Document Manager
M/S 010
U.S. Department of Energy
Office of Civilian Radioactive Waste Management
Yucca Mountain Site Characterization Office
P.O. Box 30307
North Las Vegas, NV 89036-0307

Dear Dr. Summerson:

In accordance with the National Environmental Policy Act (NEPA), Section 309 of the Clean Air Act, and the Council on Environmental Quality's implementing regulations (40 CFR 1500-1508), the Environmental Protection Agency (EPA) is providing you comments on the Supplement to the Draft Environmental Impact Statement (EIS) for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada, dated May 2001 (DOE/EIS-0250D-S, CEQ # 010159).

The Proposed Action addressed in the draft EIS was to construct, operate, monitor, and eventually close a geologic repository at Yucca Mountain in southern Nevada for the disposal of spent nuclear fuel and high-level radioactive waste currently in storage at 72 commercial and five Department of Energy (DOE) sites across the nation. The draft EIS described the potential environmental impacts of constructing, operating, monitoring and closing the repository.

While the fundamental repository concept has not changed from that described in the draft EIS, the design has continued to evolve. That evolution is described in the *Yucca Mountain Science and Engineering Report,* a summary of which was distributed to recipients of the Supplement. The Supplement evaluates the potential impacts of the so-called *flexible design* described in the Science and Engineering Report, and compares these to the impacts described in the draft EIS. EPA commends DOE for preparing the May 2001 Supplement to update the information in the draft EIS.

EPA's comments on the Supplement are detailed in the enclosure. We request additional information to clarify certain information, impacts and conclusions drawn in the Supplement.
1... Because the Supplement is limited in scope, it does not address the comments EPA made on the draft EIS regarding the national transportation aspects of the project, nor does it provide most of

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1 cont. the additional data we requested on the projects's potential environmental impacts. EPA therefore continues to have environmental concerns with the project, per our rating of the draft EIS as "EC-2", Environmental Concerns-Insufficient Information.

EPA also notes that although this Supplement updates the repository design with current information, research at Yucca Mountain continues and DOE expects to make further refinements even after preparing the final EIS. In preparing the EIS at this stage of this complex, long-term project, DOE has determined that the range of operating modes in the current flexible design will produce environmental impacts representative of the range produced by foreseeable future designs and operating modes, and has conservatively estimated the bounds of the potential impacts of the flexible design. DOE is continuing to analyze the performance of the repository under different operating modes in an attempt to further reduce uncertainties and improve its performance.

2 EPA appreciates the benefits of ongoing research and recognizes the desirability of achieving the safest possible repository performance. If ongoing scientific studies support the EIS's bounding information, then the NEPA requirement to disclose the environmental impacts of a project should be satisfied. However, EPA encourages DOE to provide public review of and comment on new information that affects the project's design and operation. And, CEQ regulations (sec. 1502.9) require a supplement to a draft or final EIS when an agency makes substantial changes to a proposed action relevant to environmental concerns or where there are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.

3 As a general comment, EPA notes that since this supplement was prepared, the EPA Administrator has signed 40 CFR Part 197, *Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada."* The final EIS and any other supplements should reference these standards. Also, any subsequent documents should incorporate the provisions of Part 197 into the discussion and comparisons made in the EIS, e.g., the references to the "postclosure receptor" being located 20 kilometers south of the repository are outdated.

Thank you for the opportunity to review this Supplement. If you have any questions or would like to meet with EPA on these comments, please contact Susan Absher of my staff. She may be reached at 202/564-7151.

Sincerely,

Anne Norton Miller
Acting Director
Office of Federal Activities

Enclosure

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SPECIFIC EPA COMMENTS
Supplement to the Draft EIS for a Geologic Repository for the Disposal of
Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain
(DOE/EIS-0250D-S, May 2001)

4 Page 2-11, Section 2.3.1. This section describes repository closure, but provides no details on post-closure monitoring other than a reference to the NRC proposed rules. The final EIS should provide a more detailed description.

5 Page 2-12, Section 2.3.2.1. In the final sentence of the first paragraph, it is unclear why the "basic facilities for personnel support, warehousing, security, a concrete plant for fabricating and curing precast components and supplying concrete for in-place casting, and transportation (motor pool)" are inside the radiation control area (RCA). If such facilities have radiation concerns, the reasons and impacts should be explained.

6 Page 2-13, Figure 2-4. The "potential commercial spent nuclear fuel aging area" is inside the RCA but apparently outside the security station. What security controls will there be for this area?

7 Page 2-21, Section 2.3.3.2. The second paragraph states that "this low ventilation rate [0.1 cubic meter per second] would permit monitoring of the air stream exhausting from the drifts for leaks of radioactive material, but would not contribute significantly to removal of heat from the emplacement drifts." This is followed by a discussion of the higher ventilation rate [15 cubic meters per second] under the new flexible design, but there is no mention of monitoring. Does this mean that the flexible design does not allow for monitoring of the exhaust air? If so, this raises public health and on-site safety concerns. The final design must include effective monitoring and a system to divert the air into high-efficiency filtering systems in case releases are detected.

8 Page 2-31, Section 2.4. The last two sentences of the fourth paragraph state: "The effect of drift spacing on these related parameters would be less than the effect of waste package spacing in the analytical scenarios presented in this Supplement. Therefore, DOE did not perform a quantitative evaluation of the environmental impacts of variable drift spacing." EPA questions the basis for this statement and conclusion. What about interactions? The distance between waste packages is an independent design factor from the distance between drifts. Therefore, there is a range of potential conditions and impacts that could occur. These impacts should be assessed or a more detailed rationale provided for the statements and conclusion.

9 Page 2-31, Section 2.4. The first sentence of the final paragraph identifies "Uncertainties in future funding profiles or the order of...waste shipments" could affect the construction of the repository. The next sentence states that this approach could "potentially increase confidence in meeting the schedule for waste receipt and emplacement." DOE should explain how uncertainties in funding can result in increased confidence for meeting the schedule.

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10 Page 3-11, Section 3.1.8, Accidents. All of the doses to the maximally exposed individuals exceed by 2.5 to 3.2 times the current radionuclide NESHAPs standards. The information to determine these results should be provided.

11 Page 3-17, Section 3.1.14, Transportation. We note that the transportation impacts are increased for the *flexible design* over the draft EIS design. These increased impacts, as well as those noted in other areas, should be incorporated into the final EIS analysis.

12 Page 3-20, Section 3.2.2. Following Table 3-12 is a statement that the integrating software for the Total System Performance Assessment has changed from that used for the original DEIS to GoldSim®, and that "GoldSim® incorporates much the same performance assessment calculational approach, but with substantial improvements in the user interface and data handling." The final EIS should provide support for this statement because changing the software which integrates the many programs which are used in the Total System Performance Assessment (TSPA) introduces uncertainty into the comparison of previous results.

13 Page 3-21, Table 3-13. This table lists a change in the "Unsaturated zone flow" as "Coupling between thermal, hydrologic, and chemical effects." What is the status of the modeling and research on these coupled processes?

14 Page 22 of the Executive Summary of the Yucca Mountain Science and Engineering Report. Under Performance Confirmation and Monitoring is stated, "Performance confirmation and monitoring activities would continue throughout the preclosure period, which could extend up to 300 years." Does DOE have confidence in such a long performance-monitoring period particularly in light of the statement on page 2-31 of the Supplement about "uncertain funding" for even the relatively shorter term construction of the disposal system and transporting of the waste?

4